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WAR DEPARTMENT

U.S. Dept. of Army

TECHNICAL MANUAL

**RADIO SETS SCR-193-A, SCR-193-B
SCR-193-C, SCR-193-D, AND SCR-193-E**

April 12, 1941



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**RADIO SETS SCR-193-A,
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SIGNAL CORPS

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SECTION I

GENERAL

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1. Purpose.—Radio sets SCR-193-A, SCR-193-B, SCR-193-C, SCR-193-D, and SCR-193-E are designed for installation in vehicles for the purpose of providing intervehicular communication whether the vehicles are stationary or moving. Modifications may appear from time to time to adapt these radio sets to new types of vehicles, in which case suitable changes in this manual will be issued.

a. Radio sets SCR-193-A, SCR-193-B, SCR-193-C, SCR-193-D, and SCR-193-E are designed for use in light tank M2A3, scout car M3, combat car M1A1, scout car M3A1, and truck, ½-ton, 4 x 4, command (radio), respectively. These sets may also be installed in other vehicles if a proper battery is available and if proper shielding against ignition noises is provided. These radio sets have been assigned different type numbers because of minor differences in component parts necessary to effect suitable installations in the particular vehicles concerned.

b. The information and instructions herein apply equally to all radio sets covered by this manual unless a particular one is specifically referred to by type number.

2. Power.—*a. Input.*—The primary source of power required to operate the transmitters and receivers of these sets is the 12-volt vehicular storage battery (not a radio set component). For normal storage battery current consumption of the receivers and transmitters under various modes of operation, see paragraph 36.

b. Output.—The transmitters have a nominal output rating of 75 watts.

3. Modes of transmission and reception.—These radio sets transmit and receive the following:

a. Continuous-wave telegraph signals, abbreviated as “c. w.”

b. Tone-modulated, continuous-wave telegraph signals, abbreviated as “tone.”

c. Voice-modulated, continuous-wave telephone signals, abbreviated as “voice.”

4. Distance ranges.—The distance between stations over which communication may be established with these radio sets will vary considerably; it will depend on the frequency and the mode of operation, and on topographic, atmospheric, and electrical conditions. In general, approximate reliable ranges of these sets in miles are as follows:

	Cw	Tone	Voice
Both stationary.....	60	40	20
Both moving.....	30	20	15

5. Frequency ranges.—*a.* The receivers of these sets have a frequency range of 1,500 to 18,000 kilocycles (kc.).

b. The transmitters have a frequency range of 1,500 to 4,500 kc. When the component transmitter tuning unit TU-5-A is employed, the frequency range is 1,500 to 3,000 kc. When transmitter tuning unit TU-6-A is used, the frequency range is 3,000 to 4,500 kc.

6. Channels.—*a.* The frequency separation required between stations operating in the same vicinity depends upon several variable factors such as the—

- (1) Distance between transmitting and receiving stations.
- (2) Selectivity of the receivers with which the transmitter is likely to interfere.
- (3) Frequency and mode of transmission.
- (4) Nature of terrain.

b. In general, a separation equivalent to approximately one percent of the highest frequency employed is practical. Approximately 75 channels with a 40 kc. separation are available, providing sets adjacent in frequency are not closer than a few miles.

7. Use.—Radio sets SCR-193-A, SCR-193-B, SCR-193-C, SCR-193-D, and SCR-193-E may be used in two-way net communication with the same set or other types of transmitting radio sets listed in the left-hand column of figure 1, provided all radio sets used are within the maximum distance range of the least powerful set. Figure 1 shows the frequency bands of radio transmitters which are a component of each of the listed sets and the bands of the other types of radio sets which overlap them. Authorized frequencies which lie within the overlapping bands may be selected for such communication.

8. Transport.—*a.* Each vehicle named in paragraph 1 is prepared during manufacture with all the necessary mounting holes and many of the fittings required for radio installation. The ignition system is shielded, a 12-volt, 180-ampere-hour storage battery is installed, and a 50-ampere generator is employed in the vehicle to maintain the charge of the battery. For information relative to the installation of these sets, see paragraph 22.

b. All set components are designed for vehicular use. Suitable shock mountings are provided to prevent damage from excessive shock or vibration.

9. Supply.—These sets are not stocked as complete units but are made up from component parts which are requisitioned, stored, and issued separately. While the Signal Corps General Catalog is controlling in regard to these component parts, they are indicated in this manual for information.

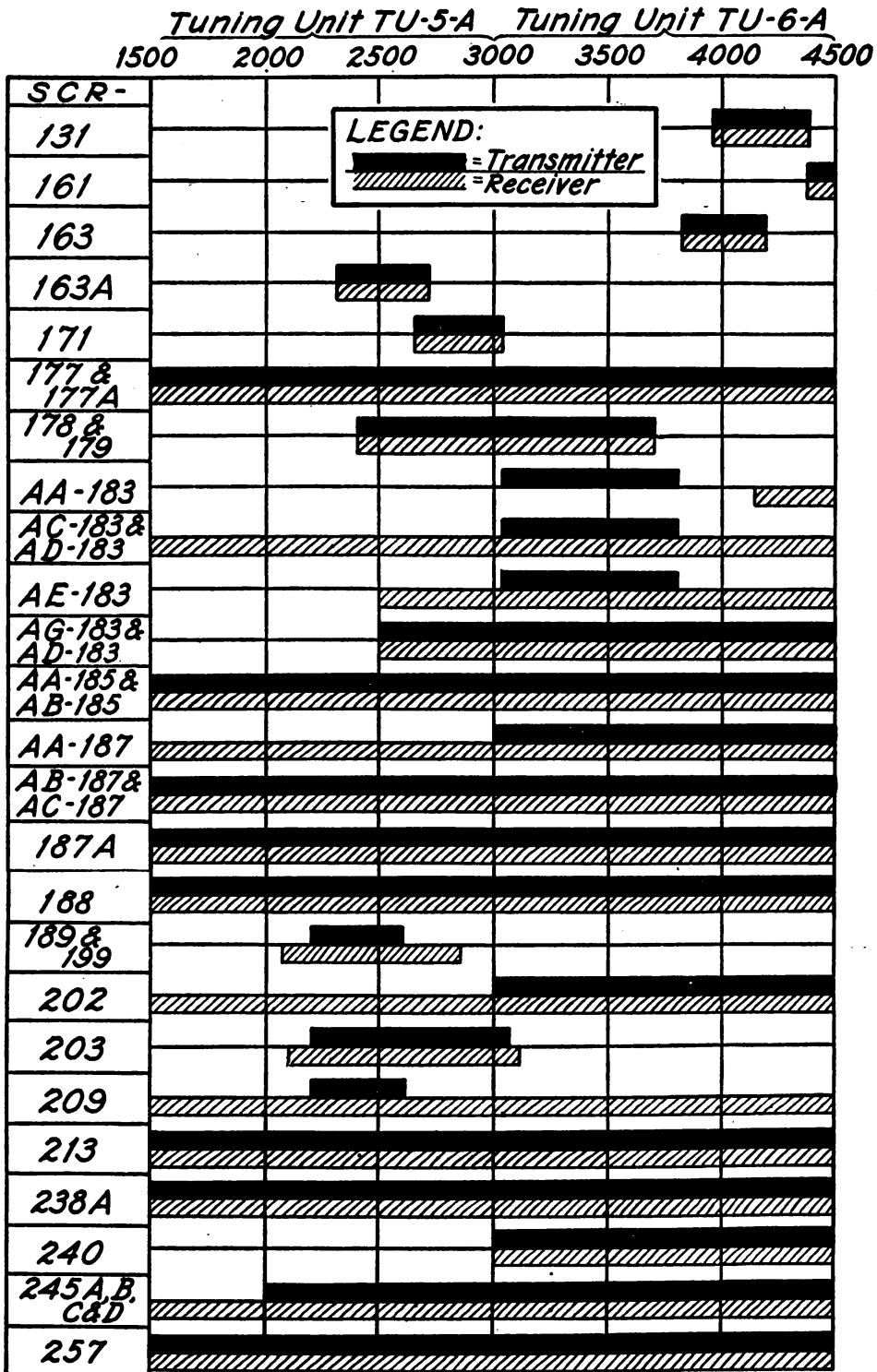


FIGURE 1.—Transmitter frequency band of radio transmitters BC-191-A and BC-191-C.

10. Weight and volume.—*a.* The approximate weights and volumes for the assembled sets are as follows:

Radio sets	Weight	Volume
	<i>Pounds</i>	<i>Cubic feet</i>
SCR-193-A.....	230	4.1
SCR-193-B.....	224	4.1
SCR-193-C.....	234	4.1
SCR-193-D.....	210	4.1
SCR-193-E.....	210	4.1

b. Dimensions and weights of components are given in detail in paragraph 40.

11. Major components.—*a. Radio set SCR-193-A.*—This set is designed for installation in light tank M2A3. The major components of this radio set are—

- (1) Radio transmitter BC-191-A.
- (2) Transmitter tuning units TU-5-A and TU-6-A.
- (3) Radio receiver BC-312.
- (4) Control box BC-321.
- (5) Mast sections MS-49 to MS-53, inclusive, and mast base MP-37.
- (6) Case CS-48, and boxes BX-8, BX-19, and BX-21.
- (7) Covers BG-67, BG-75, BG-78, BG-79, and roll BG-56.
- (8) Dynamotor unit BD-77-A.
- (9) Junction box TM-188.
- (10) The terminal box.

b. Radio set SCR-193-B.—This set is designed for installation in scout car M3. It comprises the same major components as does the radio set SCR-193-A except that it employs control box BC-309, and does not employ junction box TM-188 and box BX-21. Other minor differences are in the length of cords necessary to interconnect the component parts properly.

c. Radio set SCR-193-C.—This set is designed for installation in combat car M1A1. It comprises the same major components as does radio set SCR-193-A, except that in addition it employs a conduit CT-4, a connector bulkhead, and spacers for the control box BC-321.

d. Radio set SCR-193-D.—This set is designed for installation in scout car M3A1. The major components of this set are—

- (1) Radio transmitter BC-191-C.
- (2) Radio receiver BC-312-C.

- (3) Dynamotor BD-77-B.
- (4) Transmitter tuning unit TU-5-A and TU-6-A.
- (5) Mast sections MS-49 to MS-53, inclusive, and mast base MP-37.
- (6) The terminal box.
- (7) Covers BG-67, BG-75, BG-78, BG-79, BG-84, and roll BG-56-A.
- (8) Boxes BX-8, BX-19, BX-21, and case CS-48.

Items (1) to (3), inclusive, carry type numbers denoting a change from similar components of radio sets SCR-193-A, SCR-193-B, and SCR-193-C. However, changes in each of these major components are minor in character.

e. Radio set SCR-193-E.—This set is designed for installation in a truck, $\frac{1}{2}$ -ton 4 x 4, command (radio). It comprises the same major components as does the radio set SCR-193-D, except that covers BG-75, BG-78, BG-79, BG-84, and box BX-21 are not furnished, in lieu of which the major components are installed in cabinet CH-60. Other minor differences are in the length of cords necessary to interconnect the component parts.

12. Radio transmitters BC-191-A and BC-191-C, and transmitter tuning units TU-5-A and TU-6-A.—The transmitter elements (figs. 2, 3, and 4) are housed in a metal cabinet composed of a metal front panel, metal top, sides, back, and bottom supported by a metal frame. The transmitter includes a calibration chart, pilot lamp LM-27, and shock mounting FT-151-B. Either transmitter tuning unit may be plugged into a compartment in the left front part of the transmitter so that the tuning unit front panel becomes a part of the transmitter front panel. Extensions at the corners of the bottom plate of the transmitter cabinet are provided for securing to the mounting FT-151-B. Releasing the snap slides of this mounting permits the cabinet to be lifted from the mounting. Releasing two snap slide catches on the front of the cabinet permits removal of the tube compartment shield and provides access to the transmitter tube compartment. Removal of the tube compartment shield and the transmitter top provides access to the filament resistor connection board. Removal of the back plate permits access to other circuit elements of the transmitter. The calibration chart is held in place in the center of the transmitter tuning unit by a frame and four thumb-screws. Access to the neutralizing capacitor adjustment mechanism may be obtained by removing this chart. Four sockets are provided, located centrally on the left side and along the bottom of the transmitter to receive the sockets of necessary power and control cords. (See figs. 12 and 15.) Covers are provided to protect unused sockets.

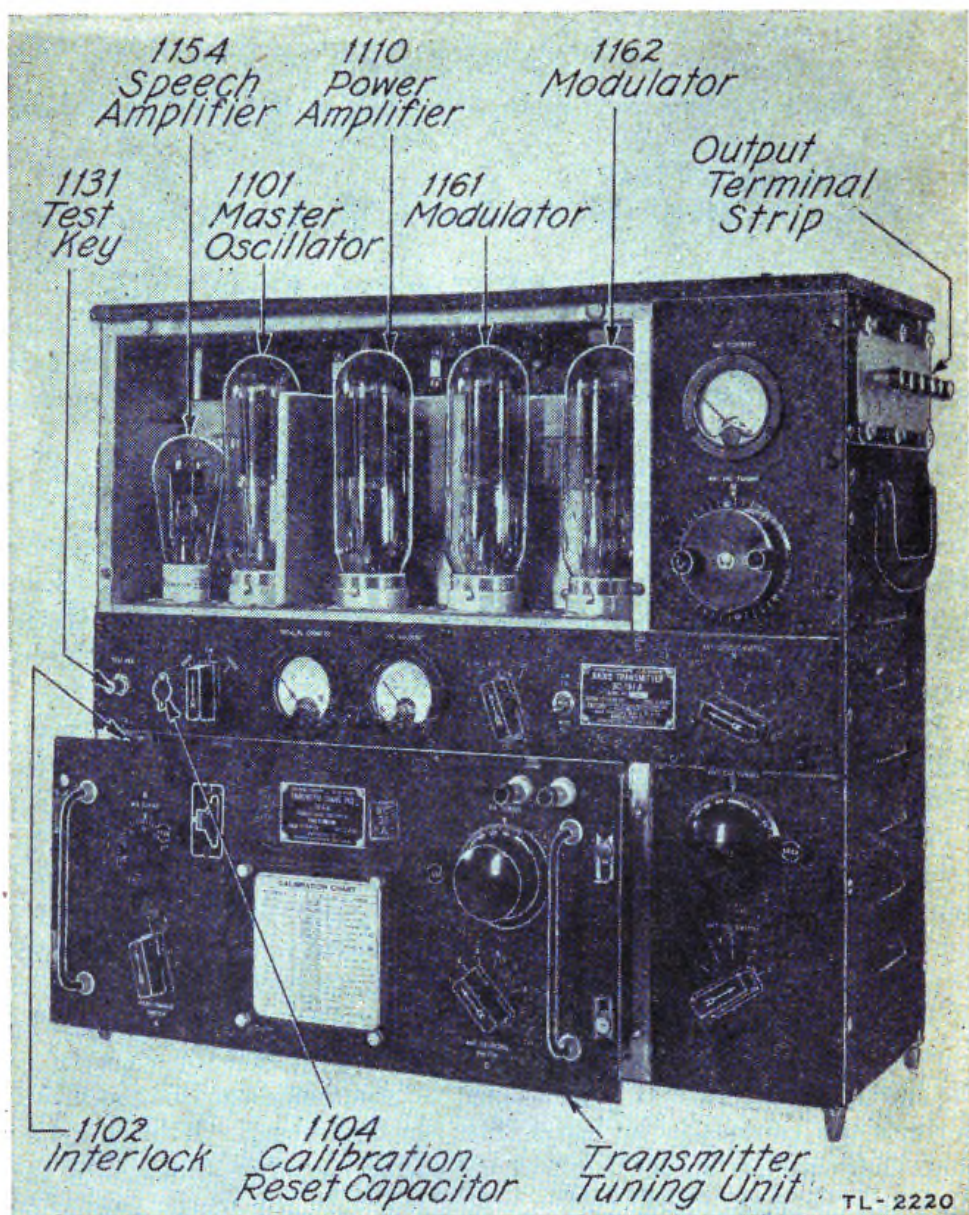


FIGURE 2.—Radio transmitter BC-191-A, with tube compartment shield removed and transmitter tuning unit TU-6-A partially inserted.

An output terminal strip of micalex (fig. 3) may be plugged into either of two output terminal plug boards (fig. 4), one of which is located near the top on the right side of the transmitter and the other of which is near the right on the top of the transmitter. The terminal strip is protected by a shield M-191. Space limitations and the location of

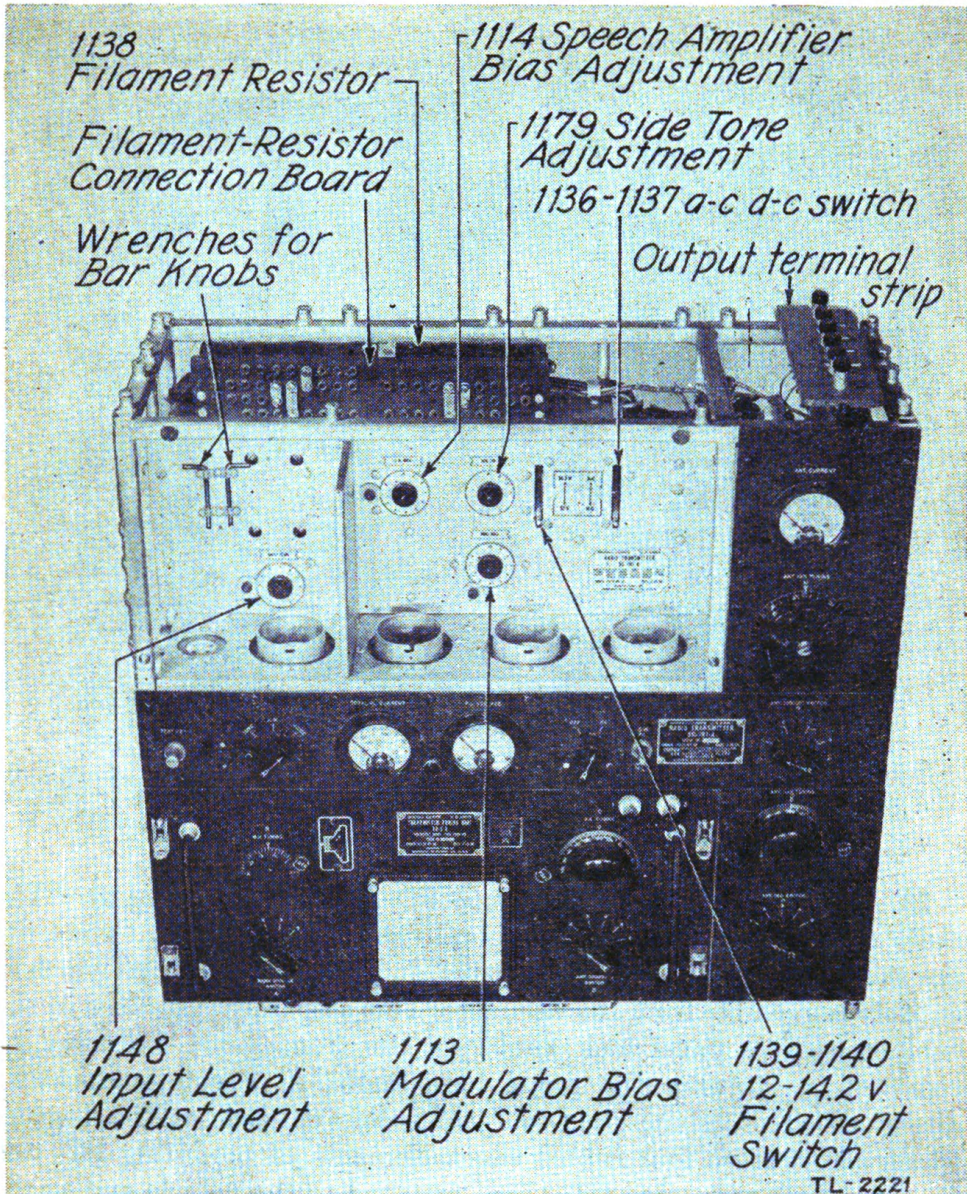


FIGURE 3.—Radio transmitter BC-191-A, with tube compartment shield and top cover off, tubes removed, and transmitter tuning unit TU-5-A in place.

the radio transmitter determine the installation used. Ventilation is provided by louvres in the sides, back, and tube compartment shield. Rubber shock mounting FT-172 is fastened to the vehicle and top of the cabinet to provide additional support for the transmitter.

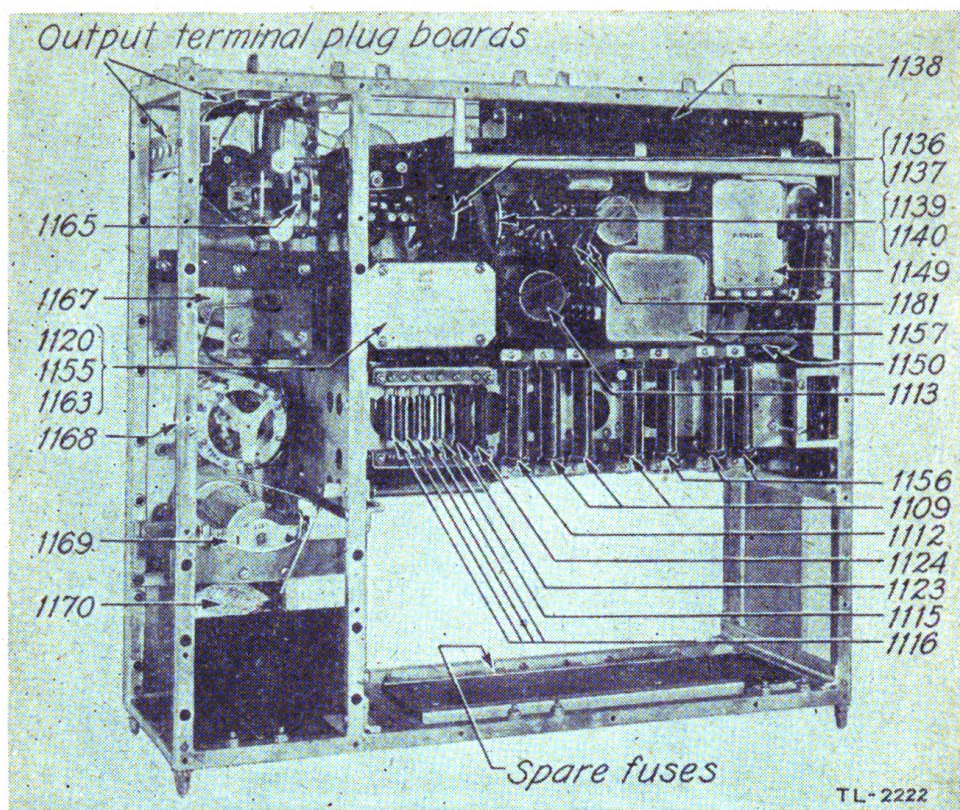
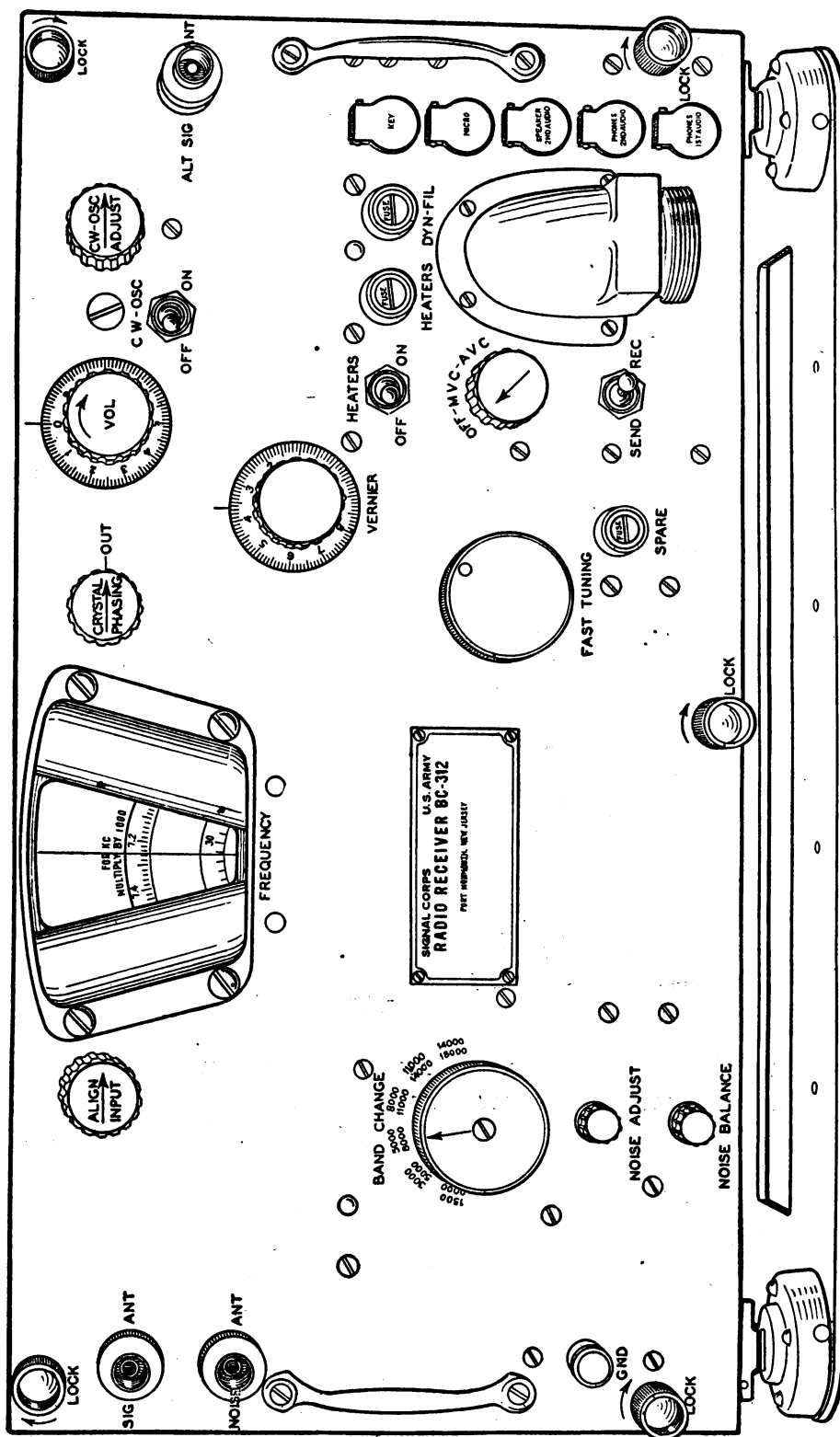


FIGURE 4.—Radio transmitter BC-191-A, rear view, shields removed.

13. Radio receivers BC-312 and BC-312-C (figs. 5 and 6).—The radio receiver is contained in a metal cabinet. The circuit elements are mounted on a metal front panel and chassis assembly which is entirely removable from the cabinet. This assembly is secured in the cabinet by five panel lock knobs on the front panel and may be removed by turning the panel lock knobs in a counterclockwise direction. The cabinet has four snap-slide catches at the bottom which secure it on four rubber shock elements of mounting FT-162. Rubber shock mounting FT-178 is fastened to the vehicle and to the side of the cabinet to provide additional support for the receiver. Fuses FU-21, lamp LM-27, and mounting FT-162 are included as parts of the receiver.

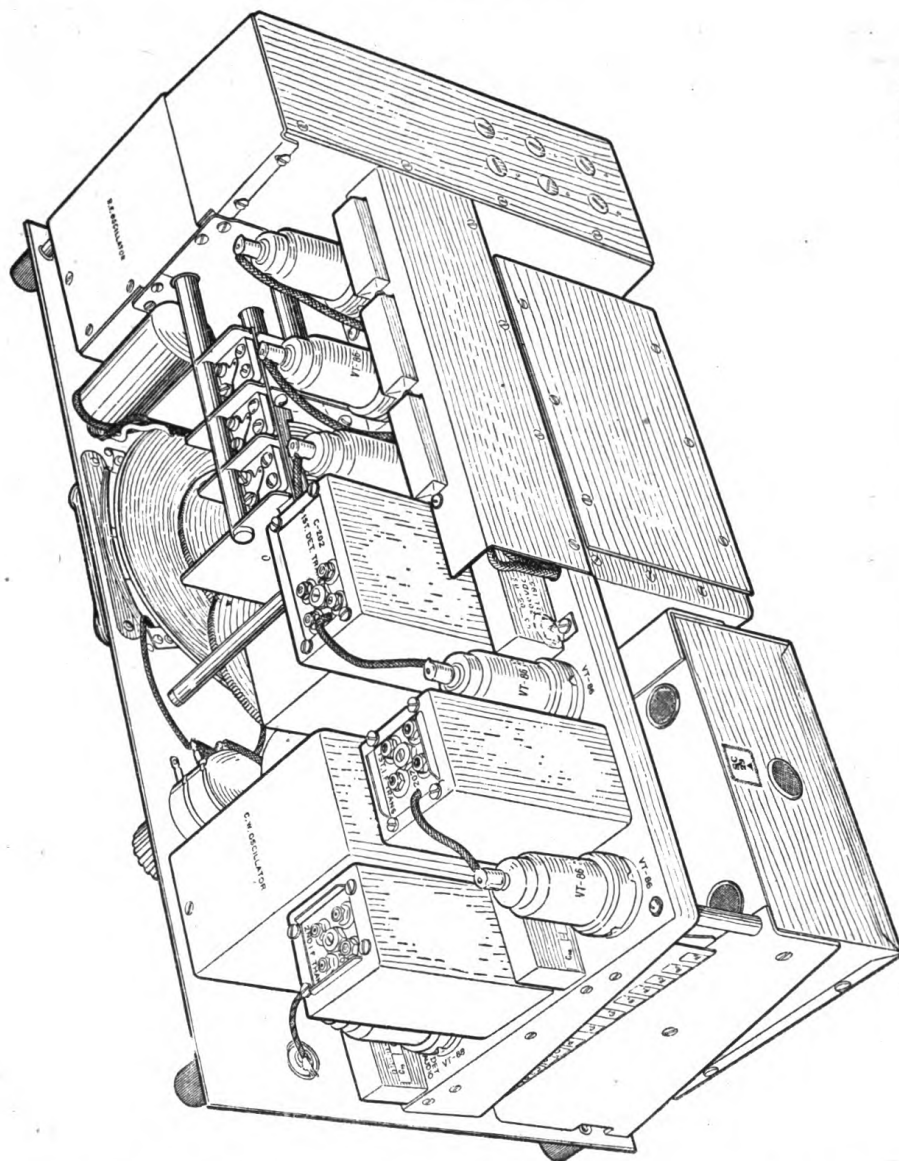
14. Control box BC-321 (fig. 7).—This control box consists of a metal box rigidly secured to the vehicle by means of a metal bracket. Removal of the two volume control knobs and four screws on the front plate provides access to the interior elements of the box.

15. Radio control box BC-309 (fig. 8).—This control box consists of a metal box rigidly secured to the vehicle by means of four



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FIGURE 5.—Radio receiver BC-312, front view.



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FIGURE 6.—Radio receiver BC-312, chassis rear view.

screws through the rear plate. Removal of the four screws in the sides of the box near the base provides access to the interior elements.

16. Dynamotor units BD-77-A and BD-77-B (fig. 9).—Each of these units consists of a dynamotor upon which is mounted a metal relay fuse box. The base of the unit is provided with four snap-slide catches for securing the unit to the mounting FT-107. Sockets and a $\frac{1}{16}$ inch diameter conduit hole in the left-side panel of the relay fuse box provide for power input leads. Releasing the four snap slide catches on the top of the relay fuse box permits removal of the cover and gives access to circuit elements within the box (fig. 10). The required fuses and the mounting FT-107 are included as parts of the dynamotor unit.

17. Mast sections MS-49 to MS-53, and mast base MP-37 (fig. 11).—The five mast sections are made of high tensile-strength flexible steel. Mast section MS-49 forms the top of the antenna.

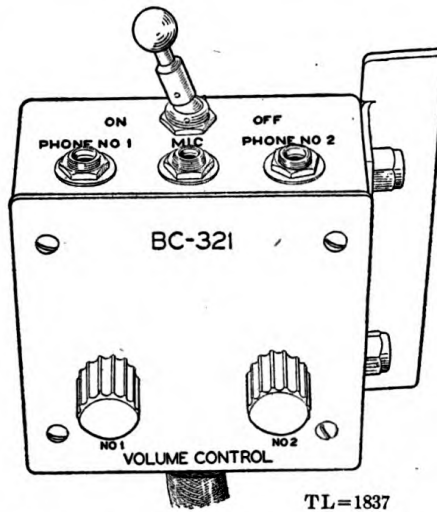


FIGURE 7.—Control box BC-321, front and top view.

when all sections are used and the others follow in sequence of their type numbers. Mast section MS-53 screws into mast base MP-37,

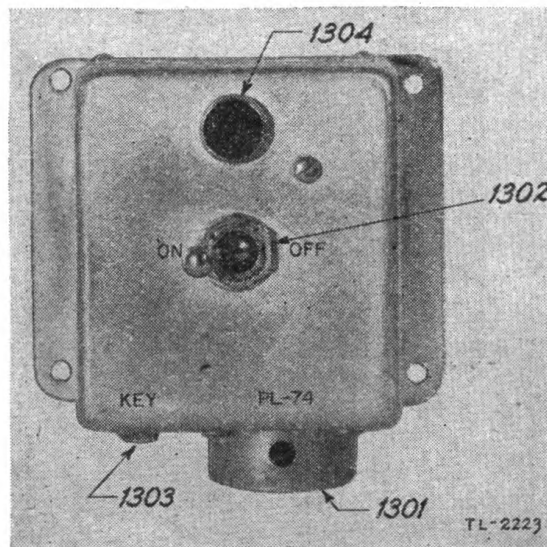


FIGURE 8.—Radio control box BC-309.

which is rigidly secured to the vehicle. A large helical spring in the mast base provides additional flexibility to the antenna. The upper end of mast section MS-49 terminates in a blunt point. The lower

end of each mast section is fitted with a serrated shank and screw for engaging the threaded upper ends of the next mast sections. Ends which are joined in assembling have enamel marks of the same color.

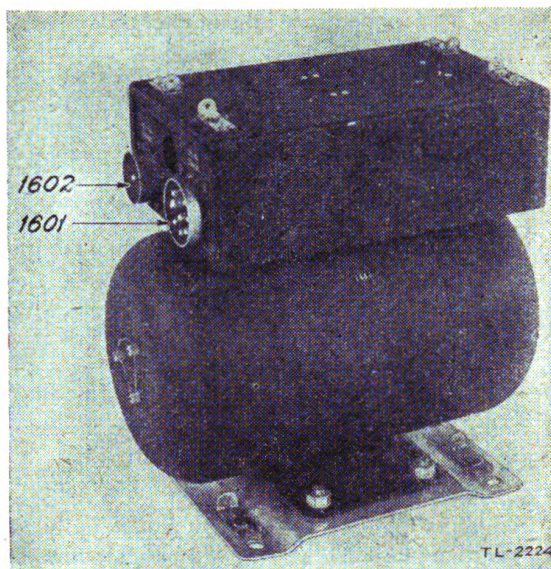


FIGURE 9.—Dynamotor unit BD-77-A.

The body of each section is enameled black and bears the type number at the lower end. The over-all length of the assembled antenna is 15½ feet.

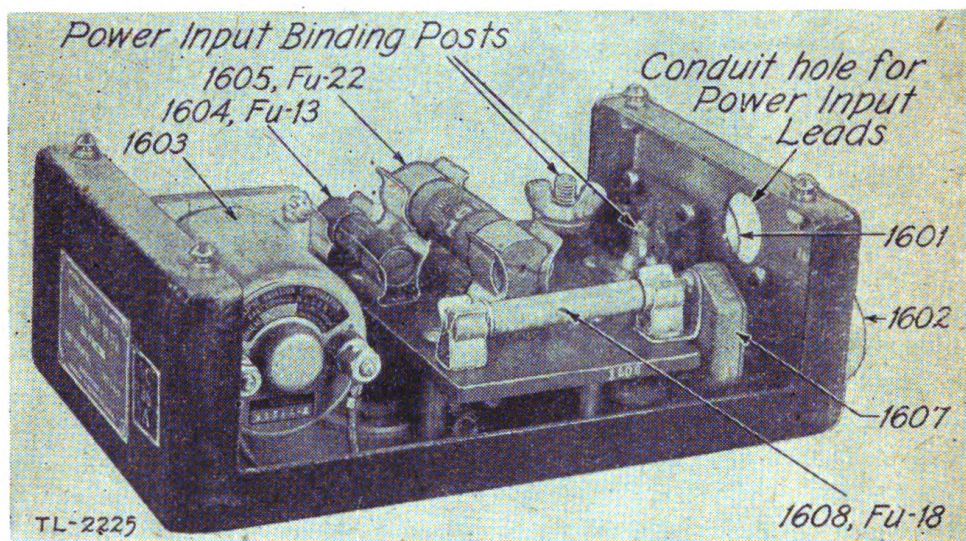


FIGURE 10.—Relay fuse box for dynamotor BD-77-A.

18. Case CS-48, and boxes BX-8, BX-19, and BX-21.—Case CS-48 is a metal container into which either one of the transmitter

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tuning units may be inserted and mounted or carried. The tuning unit is secured in the case by the same four snap-slide catches that are used to secure the unit in the transmitter. Boxes BX-8 and BX-19 carry spare tubes for the transmitter and spare tubes for the receiver, respectively. Box BX-21 carries spare parts, and the microphone, key, and headsets when not in use. These boxes may be rigidly fastened inside the vehicle.

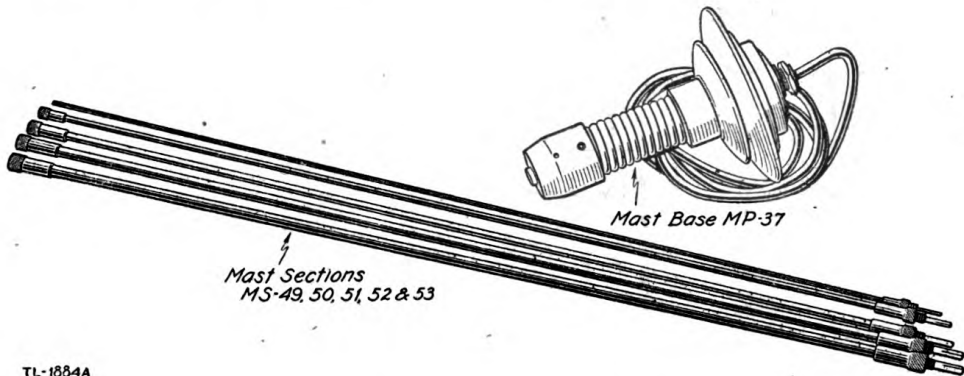


FIGURE 11.—Mast base and mast sections.

19. Covers BG-67, BG-75, BG-78, BG-79, BG-84, and rolls BG-56, BG-56-A, and cabinet CH-60.—*a. Covers.*—Cover BG-67 is made of black canvas duck and is placed over the mast base MP-37 when the antenna is not in use. It is secured to the mast base by a leather strap fastened at the bottom of the cover. Covers BG-75, BG-78, and BG-79 are made of heavy waterproofed canvas duck and protect the receiver, transmitter, and dynamotor unit, respectively. Slide fasteners on the fronts of covers BG-75 and BG-78 may be opened to provide access to the front panels of the receiver and transmitter, and the flaps released by opening the slide fasteners may be held back by snap fasteners on the tops of the covers. Openings on the sides of the latter three covers permit the entry of connecting cords to the components within. The preparation of scout car M3A1 by the Ordnance Department for the installation of radio set SCR-193-D includes the installation of a cabinet 42½ inches long, 25¼ inches high, and 10¼ inches deep. The front of this cabinet is covered by cover BG-84. This cover is permanently fastened to the top of the cabinet. When the radio set SCR-193-D is not in service, the cover is secured over the front of the cabinet by dot fasteners. When the radio set SCR-193-D is to be in service, the front of cover BG-84 is rolled upward and secured in place by three webbing elements which are snapped over the cover by means of suitably positioned snap fasteners.

b. *Rolls.*—Rolls BG-56 and BG-56-A are made of black canvas duck and each holds two sets of five mast sections each in separate

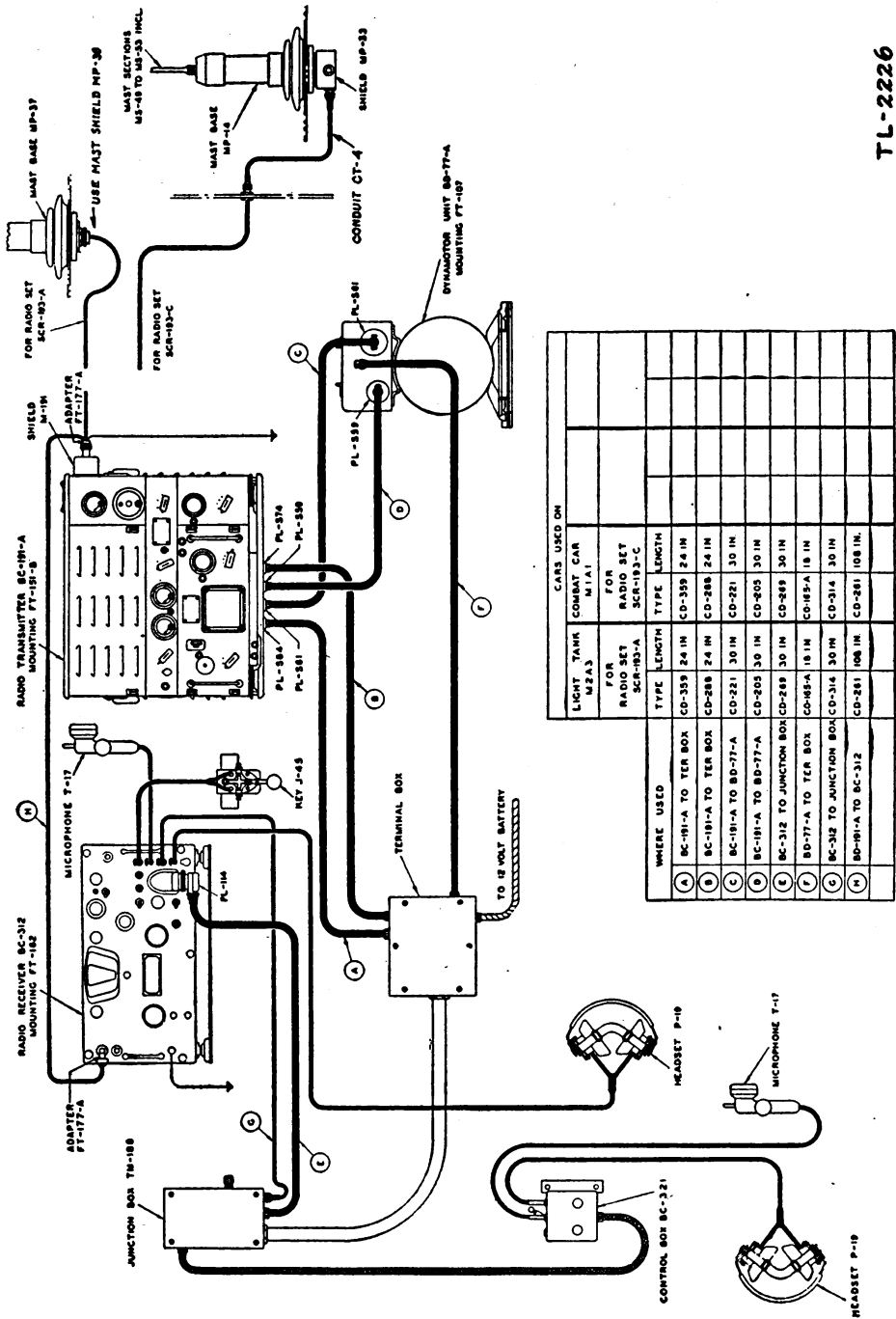


Figure 12.—Radio sets SCR-193-A and SCR-193-C, cording diagram.

compartments. The opening on one end and along the side is closed by suitable fasteners.

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two doors similarly constructed, one covering the left compartment and the other the right compartments. The doors are hinged above their center lines so that the top portion swings outward and downward to lay against the lower portion. In this position, the doors are removable from the cabinet frame by a vertical movement of the door assembly. This vertical movement disengages offset brackets, welded to

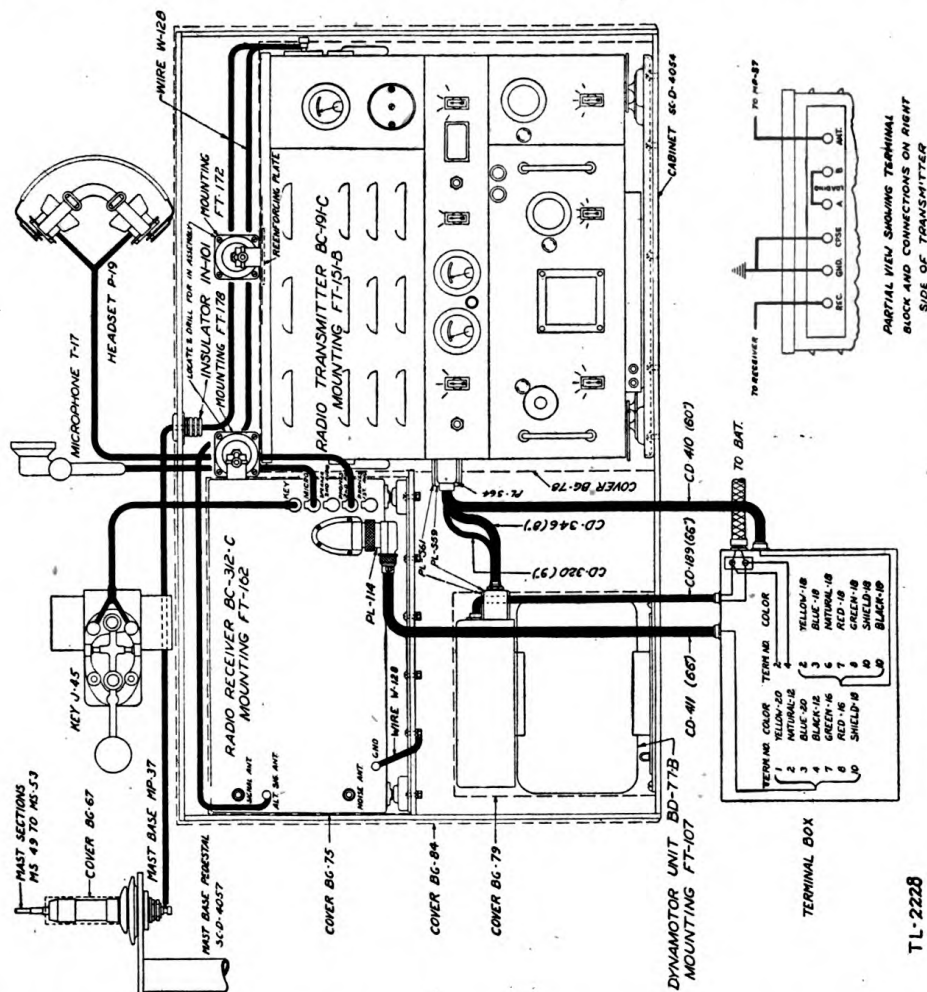


FIGURE 14.—Radio set SCR-193-D, cording diagram.

the bottom of the door assemblies, which engage a portion of the cabinet CH-60 frame when the doors are in place.

20. Vehicular accessories.—*a.* A junction box (fig. 12) is installed in light tank M2A3 and combat car M1A1 by the Ordnance Department to facilitate making of connections for the radio set SCR-193-A and SCR-193-C. In it are mounted terminal block TM-183, potentiometer RS-218, and jack JK-34-A.

b. A car terminal box (figs. 12, 13, 14, and 15) is installed during manufacture in each vehicle named in paragraph 1. In it are mounted



FIGURE 15.—Radio set SCR-193-E, cording diagram.

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SECTION II

EMPLOYMENT

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21. Limitations.—These sets have the usual limitations possessed by any radio set of the same power, mobility, and frequency range. The distance ranges (par. 4) and the channels (par. 6) must be considered approximations which are affected by many factors, the majority of which cannot be controlled by the user of the set. Some of the factors which are controllable are listed below and require the attention of the user if the sets are to operate most effectively.

a. Distance range.—(1) All other things being equal, distance range is increased by—

(a) Keeping the equipment in perfect condition through frequent inspection and correction of all defects. For inspection procedure, see paragraph 33.

(b) Using c. w. in preference to tone, and either c. w. or tone in preference to voice.

(c) Accurately tuning the transmitter and receiver.

(d) Avoiding all obstructions, either natural or man-made, particularly intervening eminences, such as tall metal structures, and power, telephone, and telegraph lines. The type and contour of the ground affect the range, and change of location to a more favorable place may increase it.

(e) The use of a higher and longer antenna than that normally used with the vehicle. A wire antenna longer than the standard mast antenna, properly installed between the mast base and a tree or other elevated object, will serve this purpose.

(2) In some situations where only very short distances are to be covered, the range may be decreased and interference reduced by the removal of one or two mast sections.

b. Channels.—All other things being equal, the number of channels available is increased by—

(1) The action indicated in *a*(1)(a), (b), and (c) above, particularly that in (b).

(2) Assignment of frequencies as far apart as possible to nets which must be located close to each other on the ground.

22. Installation.—*a. Care.*—Particular care must be observed when unpacking or handling the equipment, because when not protected by cabinets or shock mountings it may be easily damaged. Inspect equipment visually for damage when removing it from the shipping box. If necessary, clean with brush or blower before installation.

b. Instructions.—Detailed information relative to the installation of these sets is found in installation instructions for the particular type of vehicle concerned. The instructions are issued separately to using organizations, and because of their volume and possible changes, will not be covered in this manual. Figures 12, 13, 14, and 15 show the external wiring and cording diagrams of the radio sets when installed.

c. Minor installations.—Minor installations are made as indicated in (1) and (2) below. All controls, knobs, switches, jacks, etc., identified by markings will hereafter be designated by such markings. For instance, a 3-position switch on the front panel of the transmitter has the marking TONE CW VOICE above the three possible positions of the switch pointer; this switch will hereafter be designated the TONE CW VOICE switch.

(1) *Transmitters BC-191-A and BC-191-C.*—(a) If necessary, place a pilot lamp LM-27 in the socket behind the ruby reflector located between the filament voltmeter and the total plate current meter on the front panel. This is accomplished by removing the transmitter tuning unit.

(b) Remove the tube compartment shield and insert corresponding vacuum tubes in sockets marked with the respective vacuum tube Signal Corps type numbers.

(c) Inspect the fuses located in the relay fuse box associated with the dynamotor unit BD-77-A and BD-77-B. If necessary, replace with fuses FU-22, FU-13, and FU-18 as the case may be, and as indicated by the size of the fuse mounting.

(d) Remove the tuning unit TU-5-A or TU-6-A and inspect the active fuse FU-12, located in the lower portion of the transmitter BC-191-A or BC-191-C above the tuning unit compartment. See that spare fuses are in place (fig. 4).

(e) Connect a No. 14 A. W. G. insulated wire, using the minimum possible length of wire, between binding posts marked LOAD-A and LOAD-B. Connect the terminal posts marked CSPE and GND to each other in the same manner. These binding posts are located on the OUTPUT TERMINAL STRIP (fig. 2).

(2) *Receivers BC-312 and BC-312-C.*—(a) Insert two pilot lamps LM-27 in sockets which are accessible upon removal of four thumb-screws and the reflector secured thereby, from the front panel. The

reflector is the fitting covering the main tuning dial directly above the marking FREQUENCY. Replace the reflector after insertion of the pilot lamps.

(b) The receiver is ordinarily furnished with tested vacuum tubes installed. Do not remove or interchange these tubes unless they apparently become defective. If necessary, disconnect the power cord and insert tubes in sockets marked with the respective vacuum tube Signal Corps type numbers. These sockets are accessible upon removal of the front panel and chassis assembly from the cabinet with the exception of those in the CW OSCILLATOR and RF OSCILLATOR compartments. The CW OSCILLATOR tube socket is accessible upon removing the top front screw, removing a screw in the center of the right side, loosening a screw at the bottom rear, and then lifting off the compartment cover. The RF OSCILLATOR tube socket is accessible upon loosening two screws at the top right side and lifting the hinged cover of the compartment.

23. Check and adjustments prior to operation.

Caution.—Operation of this equipment involves the use of high voltages which are dangerous to life. *Operating personnel will observe safety regulations at all times. Do not change fuses or make adjustments inside equipment with the high-voltage supply on.*

a. *Check.*—Make a detailed inspection of the installation and equipment as prescribed in paragraph 33b and correct where necessary.

b. *Adjustments prior to operation.*—After making the above check, adjust the filament voltages for the transmitter as follows:

(1) Remove plugs PL-59 (figs. 12, 13, 14, and 15) from the radio transmitter and the dynamotor. These plugs and their interconnecting cord carry the high voltage supply from the dynamotor to the transmitter.

(2) Remove the front cover from the tube compartment.

(3) Place the AC DC switch in the rear of the tube compartment in the DC position.

(4) Remove *all* links from the filament-resistor connection board (see fig. 3).

(5) Place the 12V 14.2V switch in the tube compartment in the 14.2V position.

(6) On the transmitter front panel, set the TONE CW VOICE on CW and the CW FIL MOD FIL switch on CW FIL.

(7) Start the motor of the vehicle and accelerate until the vehicular storage battery is on charge and the battery voltage rises to a steady value.

(8) Place the transmitter OFF ON switch in the ON position. This should start the dynamotor and apply filament voltage to the

transmitter, but not to the tubes. Using a screw driver or a short piece of copper wire (No. 12 B&S or larger), and starting at the extreme left end of the CW FILAMENT row, successively connect between a stud on the CW FILAMENT row and a stud in the 14V row directly under it (see fig. 16). On each connection, the tube filament will light and the filament voltmeter will indicate the applied voltage. When a connection is found that will cause the filament voltmeter to read 10.5 volts, place the OFF ON switch in the OFF position and connect a link between the two studs just selected.

(9) Set the TONE CW VOICE switch on VOICE and the CW FIL MOD FIL switch on MOD FIL. Repeat the operation in (8) above, substituting the MOD FILAMENT row of studs and the

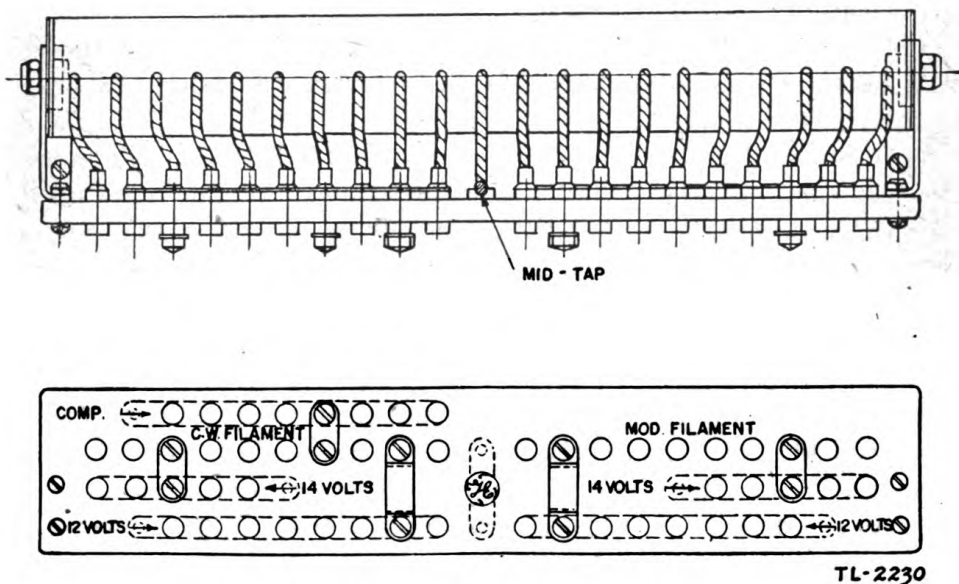


FIGURE 16.—Filament-resistor connection board.

14V row of studs directly under it for the studs used in operation (8) above, but start at the extreme right end of the MOD FILAMENT row.

(10) Set the CW FIL MOD FIL switch on CW FIL and the TONE CW VOICE switch on VOICE. Place the OFF ON switch in the ON position. The CW FILAMENT voltage will now be less than 10 volts. In the same manner as in (8) above, starting with the first stud to the right of the connection made in (8) above and successively moving to the right, connect pairs of studs on the COMP and CW rows until a pair is found which causes the filament voltmeter to read 10.5 volts. Turn the OFF ON switch to the OFF position. Connect a link between the studs just located.

(11) Shut the motor of the vehicle off and place the 12V 14.2V switch in the 12V position.

(12) Set the TONE CW VOICE switch on CW and the CW FIL MOD FIL switch on CW FIL.

(13) Place the transmitter OFF ON switch in the ON position, and allow the battery voltage to fall to a steady value. The filament voltage will now be found to be less than 10.5 volts. With a screw-driver or a short piece of copper wire (No. 12 B&S or larger), starting at the extreme right end of the CW FILAMENT row, successively connect between a stud on the CW FILAMENT row the 12V row directly under it, until a connection is found that causes the filament voltmeter to read 10.5 volts. Place the OFF ON switch in the OFF position, and connect the long link provided between the pair of studs just located.

(14) Set the TONE CW VOICE switch on TONE and the CW FIL MOD FIL switch on MOD FIL. Place the OFF ON switch in the ON position.

(15) Starting with the left end of the MOD FILAMENT row, in the manner indicated above, successively move to the right until a pair of studs on the MOD FILAMENT row and the 12V row are found that will cause the filament voltmeter to read 10.5 volts. Place the OFF ON switch in the OFF position. Connect the long link provided between the pair of studs just located.

(16) Place the 12V 14.2V switch in the 14.2V position. *When it is certain that the dynamotor has stopped*, replace the tube compartment shield and replace the plugs PL-59 in the dynamotor and transmitter sockets. The filament voltage has now been adjusted so that under actual operating conditions, the voltage at the tube filament connections will be *10 volts* under all conditions of operation.

c. Special adjustments.—When necessary, special adjustments are made as prescribed in paragraph 35.

24. Operation in general.—*a. Interference.*—(1) Interference is minimized by c. w. operation and by the use of the crystal filter.

(2) Power lines may contribute a source of interference, particularly at the higher frequencies. Avoid operation in the vicinity of power lines.

(3) A form of interference, called track static, may be generated by track laying vehicles. This form of interference must be cured at the source.

(4) A form of interference due to improper joining of metal parts of the vehicle may be prevented by care in grounding the radio equipment and carefully bonding together (connecting) all metal parts of the vehicle.

(5) In moving vehicles, vibration may cause the thermostats in the receiver BC-312 to produce noise, in which case the heaters should be turned off.

(6) The above forms of interference, and others which may be noted after some experience, may usually be identified by their characteristic noises.

b. Net operation.—If net operation is prescribed, each set in the net must be accurately tuned to the same frequency. Frequency adjustment is best accomplished with the aid of a frequency meter. *Tune all sets within the same net under substantially the same conditions.* The position and the length of the antenna, the temperature, and the battery terminal voltages must be fairly uniform. Avoid tuning in the immediate vicinity of buildings and metal structures. If operation in transit is to be effected, tune sets with engines of the vehicles running. Lock all transmitter controls after the net tuning operation.

c. Methods of operation.—(1) Always operate the transmitter with the antenna tuned. This is particularly important in net operation in order to maintain the correct frequency. Tone transmission, being broad, is well adapted to net operation, but produces more interference to nearby radio sets than does c. w. transmission. Voice transmission produces more interference than does tone transmission.

(2) For satisfactory net operation, and to insure that the receiver stays on net frequency, turn the HEATERS OFF ON switch of radio receiver BC-312 to the ON position for 15 to 30 minutes prior to operation, and leave it in that position during operation.

(3) So that the receiver will not be too selective during stand-by periods, turn the CRYSTAL PHASING control, which controls the use of the crystal filter, to the OUT position.

d. Precautions.—(1) *Controls.*—Observe care in handling all of the controls. Most of them are equipped with stops to limit their movement. Forcing a control beyond its normal stop will seriously damage the equipment. This caution applies particularly in the receiver to controls marked VERNIER, CRYSTAL PHASING, and VOL.

(2) *Serial numbers.*—The serial numbers of transmitter tuning units must be identical with the serial number of the transmitter with which used. Do not interchange transmitter tuning units with those of other transmitters.

(3) *Vacuum tubes.*—A marked decrease in the life of the transmitter vacuum tubes results from over or under voltage applied to the filaments. Check the filament voltage frequently and adjust, if necessary, as prescribed in paragraph 23.

(4) *Band change.*—In changing the frequency band of the receiver it is possible to stop the BAND CHANGE switch between two

settings. Turn this switch until it definitely engages the desired band.

(5) *Receiver power cord.*—Avoid undue pulling or stressing of this cord. Disconnect the cord from the receiver before the receiver panel and chassis assembly is removed from the cabinet. At no time apply power to the receiver while the panel and chassis assembly is being handled.

(6) *SEND REC switch.*—When the set is not being used during actual transmission periods, place the SEND REC switch in the REC position. If left in the SEND position, there is a small current drain on the battery.

25. Transmitting.—*a. Controls* (figs. 2, 3, 5, 7, and 8).—Transmission is accomplished or controlled by the following:

(1) Dynamotor unit BD-77-A (SCR-193-A, SCR-193-B, SCR-193-C).

(2) Dynamotor unit BD-77-B (SCR-193-D, SCR-193-E).

(3) At control box BC-321 (SCR-193-A, SCR-193-B, SCR-193-C).

(a) OFF ON switch.

(b) MICRO jack and microphone T-17 connected thereto for voice transmission.

(c) MICRO jack and key J-45 connected thereto for c. w. transmission (SCR-193-B only).

(4) At radio control box BC-309 (SCR-193-B).

(a) OFF ON switch.

(b) KEY jack and key J-45 connected thereto for c. w. transmission.

(5) On radio receiver BC-312, BC-312-C.

(a) KEY and MICRO jacks and a key and microphone for c. w. and tone, or voice, respectively, connected thereto.

(b) SEND REC switch.

(c) Cord F (see fig. 13) to conduct audio frequencies through the circuits of the terminal box to control box BC-321.

(6) On radio transmitter BC-191-A, BC-191-C or connected to it.

(a) An antenna described in paragraph 17 connected to the ANT binding post of the output terminal strip. This strip may be installed as outlined in paragraph 12.

(b) A thermocouple type, 0 to 8 ampere, radio frequency ammeter marked ANT CURRENT located in the upper right-hand corner of the front panel. This meter indicates the current output of the transmitter.

(c) An antenna inductance tuning dial, marked ANT IND TUNING, M, used for inductively tuning the antenna. It is located immediately below the antenna current ammeter.

(d) An antenna circuit switch, marked ANT CIRCUIT SWITCH, N, used to accomplish the antenna circuit changes required for tuning

the transmitter into various types of antennas. It is located directly below the antenna inductance tuning dial.

(e) An antenna capacity tuning dial, marked ANT CAP TUNING, O, located immediately below the antenna circuit switch. This control is used to adjust or tune a capacitor in the antenna circuit. It is provided with a locking mechanism so that its final position may be maintained.

(f) An antenna inductance switch, marked ANT IND SWITCH, P, used for obtaining large variations in antenna inductive loading. This switch is a 5-position switch, each position corresponding to a stop on the inductance coil and is located in the lower right-hand corner of the front panel.

(g) A filament voltmeter switch marked CW FIL and MOD FIL located to the left of the antenna circuit switch. It is used to transfer the voltmeter to either the modulator tube filaments or to the master oscillator and power amplifier filaments.

(h) A transmitter OFF ON switch located to the left of the filament voltmeter switch.

(i) A 0 to 15-volt a. c.-d. c. voltmeter marked FIL VOLTAGE located to the left of the transmitter OFF ON switch. This meter indicates the filament voltage of the modulator tubes, or master oscillator and power amplifier, as controlled by the filament voltmeter switch described in (g) above.

(j) A 0 to 500 milliamperes, direct current ammeter marked TOTAL PL CURRENT located to the left of the filament voltmeter. This meter indicates the plate current drawn by the radio transmitter and is used as a means for indicating resonance while tuning.

(k) A 3-position switch with a pointer for indicating TONE CW VOICE positions, respectively. This switch is located to the left of the plate current meter.

(l) A TEST KEY for keying the transmitter while tuning adjustments are in progress. This key is located in the left center of the transmitter.

(7) On transmitter tuning units TU-5-A and TU-6-A.

(a) A master oscillator band change switch located in the lower left-hand corner of the transmitter tuning unit. It is marked BAND CHANGE SWITCH, A, and is used for the circuit changes necessary to cover the frequency band used.

(b) The master oscillator tuning control located in the upper left-hand part of the transmitter tuning unit. It is marked MO TUNING, B, and consists of two dial mechanisms and a lock. The dial mechanism used to select the frequency also acts as a vernier and is divided into 100 divisions. The flat, fully exposed scale to the left of the dial lock

has 25 divisions and indicates hundreds, while the so-called vernier indicates tens and units.

(c) The power amplifier tuning control located in the upper right-hand part of the transmitter tuning unit. It is marked PA TUNING, C. This control is used to tune a capacitor in the tank circuit of the power amplifier and is provided with a lock to hold its final setting.

(d) The antenna coupling switch located in the lower right-hand side of the transmitter tuning unit. It is a 6-position switch marked ANT COUPLING SWITCH, D. This coupling switch selects different taps on the antenna coupling coil.

(e) Two controls, one on the transmitter and the other on the tuning unit panel, are not exposed, namely—the neutralizing capacitor and the calibration reset capacitor. Access may be had to the neutralizing capacitor adjustment mechanism upon removal of the calibration chart, and access to the calibration-reset capacitor may be had through a small port to the right of the test key. These controls are *not* normally adjusted during operation of the transmitter but may be adjusted if necessary as prescribed in paragraph 35.

b. Procedure.—The transmitter may be operated for c. w., tone, or voice transmission. *In all cases, adjust the transmitter initially for c. w. transmission.* The transmitter should be approximately tuned before the power is turned on.

(1) *For c. w. operation.*—(a) Read paragraphs 23 and 24.

(b) Turn the transmitter OFF ON switch to the OFF position.

(c) Plug into the transmitter and lock in place the transmitter tuning unit which covers the assigned frequency.

(d) Determine the dial setting for the assigned frequency from the calibration chart on the front of the transmitter tuning unit. If the prescribed frequency is between any two tabulated frequencies, interpolate the correct dial setting.

(e) Set the BAND CHANGE SWITCH, A, the MO TUNING control, B, and the PA TUNING control, C, to the numbers indicated in the proper column and opposite the correct frequency on the calibration chart.

(f) Set the ANT COUPLING SWITCH, D, on 1.

(g) Place the TONE CW VOICE switch on the CW position.

(h) Insert the plug for the key in any jack marked KEY.

(i) Set the SEND REC switch on the receiver panel to the SEND position. If the key plug is inserted in the MIC jack of control box BC-321 or the KEY jack of radio control box BC-309, turn the toggle switches in these boxes to the ON position.

(j) Move the transmitter OFF ON switch to the ON position. The dynamotor should start and the master oscillator and power amplifier tube filaments will light.

- (k) Press the TEST KEY or the transmitting key.
- (l) Tune the power amplifier circuit to resonance by varying the PA TUNING control, C, until *minimum total plate current is indicated*. When this circuit is properly tuned, the total plate current will be from 80 to 110 milliamperes.
- (m) Set the ANT CIRCUIT SWITCH, N, in position 4 for frequencies between 1500 and 2500 kc., or in position 3 for frequencies between 2500 and 4500 kc.
- (n) Set the ANT IND SWITCH, P, in position 1.
- (o) Tune the ANT IND TUNING control, M, for maximum antenna current as indicated by the ANT CURRENT meter. If the antenna does not tune to resonance, place the ANT IND SWITCH in successively higher numbered positions, and retune the ANT IND TUNING control M until resonance is obtained.
- (p) If after tuning the antenna as above, the TOTAL PL CURRENT meter reads less than 200 milliamperes, the coupling to the antenna may be increased by placing the ANT COUPLING SWITCH, D, on a higher numbered point and the antenna circuit retuned as indicated above. When finally adjusted, the total plate current should not exceed 200 milliamperes.
- (2) *The modulator bias adjustment.*—Having completed the procedure directed in (1) above—
 - (a) Note the value of total plate current when the transmitter is tuned for c. w. operation.
 - (b) Move the transmitter OFF ON switch to the OFF position.
 - (c) Place the TONE CW VOICE switch on the VOICE position.
 - (d) Move the transmitter OFF ON switch to the ON position.
 - (e) Press the TEST KEY, located to the left center of the transmitter panel, and note the current indicated on the TOTAL PL CURRENT meter. The total plate current meter should now read a current 20 ma. greater than the current noted in (a) above, as the modulator tubes are now drawing about 20 ma. (One small scale division of the TOTAL PL CURRENT meter is equivalent to a 20 ma. current change.) In event that the current change is greater or less than 20 ma., the control labeled MOD BIAS will need adjustment. (The dial on this control is so calibrated that the current drawn by the modulator tubes is inversely proportional to the setting of the dial.) The dial is rotated by using a screw driver inserted in the dial rotating device located just to the left of the MOD BIAS control (fig. 3). Proceed with the adjustment as follows:
 - (f) Release the TEST KEY.
 - (g) Move the transmitter OFF ON switch to the OFF position.
 - (h) Remove the tube compartment shield.

(i) By successive small steps, and the procedure indicated in (a) to (g), inclusive above, rotate the MOD BIAS control in a direction so as to bring the modulator plate current to the value indicated in (e) above.

Caution.—Changing vehicular battery voltage will cause a change in the total plate current drawn on c. w., and frequent checking of the value of total plate current on c. w. during the progress of the above adjustment is necessary.

(3) *For voice operation.*—With the adjustment of the MOD BIAS control completed, the adjustment of the INPUT LEVEL control is next in order. This adjustment will require the use of an additional radio set suitable to send and receive transmissions in the frequency range of the radio set SCR-193-A. This additional radio set should be located at a sufficient distance and/or operated with a reduced receiving antenna such that the receiver circuits are not overloaded by the signal strength of the transmissions from the SCR-193-A. The adjustment is accomplished as follows:

(a) Release the TEST KEY.

(b) Set the transmitter BC-191-A OFF ON switch in the OFF position.

(c) Insert the plug for the microphone in the MICRO jack.

(d) Set the SEND REC switch located on the receiver panel to the SEND position.

(e) Set the OFF ON switch located on the receiver panel in the ON position.

(f) Remove the tube compartment shield and using a screw driver inserted in the dial rotating device located to the left of the INPUT LEVEL control (fig. 3), set the dial at 1.

(g) Set the transmitter OFF ON switch to the ON position.

(h) Depress the microphone button, and using a standard speech input to the microphone, conduct a transmission to the distant radio station mentioned above. (These transmissions should be of about 30 to 45 seconds duration in order that the distant operator may judge the quality of the speech transmission.)

(i) Obtain a report as to signal strength and degree of modulation.

(j) By successive small steps, rotate the INPUT LEVEL control to higher numbered positions, by the procedure directed in (a) to (i), inclusive above, until the distant station makes a report of indistinct transmission.

(k) Reduce the setting on the INPUT LEVEL control somewhat and obtain a report from the distant station. The transmissions should now be clear and distinct.

(l) Note the value of total plate current during the transmission conducted in (k) above. This should never exceed 300 ma. Under very noisy vehicular conditions, it will be necessary to set the INPUT LEVEL control at a much lower point than that arrived at in (k) above, and raise the speech level to the microphone until the current noted above is obtained. The speech level to the microphone is raised by talking in a loud voice with the microphone touching the lips. Setting the INPUT LEVEL control too high results in over-modulation with indistinct transmissions, abnormally wide side bands with the consequent increase in interference on adjacent channels, overloading of power sources, blowing of fuses, and damage to the equipment.

(4) *For tone operation.*—Having completed the procedure directed in (1) and (2) above—

(a) Move the transmitter OFF ON switch to the OFF position.

(b) Place the TONE CW VOICE switch on the TONE position.

(c) Move the transmitter OFF ON switch to the ON position.

(d) Tone modulation may be effected by using the microphone button, transmitting key, or TEST KEY. The total plate current reading will be between 300 and 350 milliamperes.

(5) *Side tone adjustment.*—The magnitude of transmitter side tone delivered to the output circuit of the radio receiver is adjusted by means of the stepwise control, marked SIDE TONE, located in the tube compartment. (See fig. 3.) In the junction box TM-188, SCR-193-A and SCR-193-C, there is located a potentiometer RS-218 which provides for additional adjustment of the side tone.

26. Receiving.—*a. Controls* (figs. 5 and 7).—Reception is accomplished or controlled by the following:

(1) On the receiver BC-312, BC-312-C or connected to it—

(a) A 6-position switch located on the left center of the front panel marked BAND CHANGE. Each position is marked with the limiting frequencies in kilocycles of the band through which the receiver can be tuned. (See par. 31.) The BAND CHANGE switch also operates a masking plate in front of the main tuning dial.

(b) A flat disk main tuning dial located in the upper left of the front panel behind a windowed reflector and marked FREQUENCY. The dial has seven concentric scales, the outer six of which are calibrated directly in frequency. The first or inner scale is calibrated in equal division from 0 to 45 for ready position reference. The masking plate referred to in (a) above covers the frequency scales not in active use so that only the 0 to 45 scale and that pertaining to the frequency band selected by the BAND CHANGE switch may be read.

(c) Two controls on the right center of the front panel marked **FAST TUNING** and **VERNIER**, respectively. The **FAST TUNING** control rotates the main tuning dial at a reduction ratio of 25 to 1. The **VERNIER** control rotates the main tuning dial at a reduction ratio of 90 to 1. A calibration of 100 equal divisions around the periphery of the **VERNIER** control permits interpolation of the inner 0 to 45 scale of the main tuning dial. The **VERNIER** control makes one complete revolution to move the main tuning dial one graduation on the 0 to 45 scale.

(d) An antenna tuning control to the left of the main tuning dial marked **ALIGN INPUT**.

(e) A crystal filter control to the right of the main tuning dial marked **CRYSTAL PHASING**. An arrow on the control when the latter is rotated to the **OUT** marking on the panel indicates that the crystal filter is out of the receiver circuit. Other positions of the arrow indicate that the crystal filter is in the circuit. (See par. 31e and fig. 29.)

(f) A volume control to the right of the **CRYSTAL PHASING** control. It is marked **VOL** and has 100 equal divisions marked on its periphery for ready position reference. An arrow marking on the control indicates the direction of rotation for increasing volume. This control is effective for manually changing the volume when the **OFF MVC AVC** switch is in either the **MVC** or **AVC** position.

(g) A two-way toggle switch marked **CW OSC OFF ON** located to the right of the **VOL** control.

(h) A **CW OSC ADJUST** control located in the upper right-hand corner of the front panel.

(i) A 3-position switch in the lower right of the front panel marked **OFF MVC AVC**, respectively, for each position. When the arrow on this switch points to **OFF**, power is removed from the receiver. When it points to **MVC**, the receiver is turned on and manual volume control of the receiver is provided. When it points to **AVC**, the receiver is turned on and automatic volume control of the receiver is provided. See paragraph 31j for the detailed manner in which the **OFF MVC AVC** and **VOL** controls jointly function.

(j) A two-way toggle switch in the lower right of the front panel marked **SEND REC**.

(k) Two small knob controls located below the **BAND CHANGE** switch, marked **NOISE ADJUST** and **NOISE BALANCE**, respectively.

(l) A two-way toggle switch located in the right center of the front panel, marked **HEATERS OFF ON** (radio receiver BC-312 only).

(m) Three fuse holders marked FUSE on their screw caps and HEATERS, DYN-FIL, and SPARE, respectively, for the BC-312, and LAMPS, DYN-FIL, and SPARE, respectively, for the BC-312-C, on the panel immediately below. Being identical, the fuses contained within all three holders are interchangeable.

(n) Four terminals SIG ANT, NOISE ANT, GND, respectively, on the left-hand edge of the panel and ALT SIG ANT in the upper right-hand corner of the front panel in radio receiver BC-312. In radio receiver BC-312-C, two terminals are marked SIG ANT, one NOISE ANT, and one GND. They are all located along the left side of the front panel.

(o) Five jacks marked KEY, MICRO, SPEAKER 2ND AUDIO, PHONES 2ND AUDIO, and PHONES 1ST AUDIO, respectively, located on the lower right edge of the front panel. These jacks are provided for the insertion of plugs for a key, microphone, loudspeaker, and headphones, respectively.

(p) A 14-contact socket located on the front panel. Power for the receiver is supplied through a cord plug which is inserted into this socket. The leads from this power socket to the interior of the receiver are accessible upon unscrewing four screws of a protective metal cover above the socket and removing the cover.

(q) A shielded cord for connecting the antenna terminals to the antenna, or to the REC terminal of the transmitter when the latter is used with the receiver.

(r) A noise suppressor antenna, if used, is connected to the NOISE ANT terminal.

(s) A ground wire for grounding the receiver chassis to the chassis of the vehicle is connected to the GND terminal.

(2) On the control box BC-321.

(a) Two jacks located on the bottom marked PHONE NO. 1 and PHONE NO. 2 in which may be inserted plugs for two headsets for remote reception.

(b) Two controls located on the front plate marked VOLUME CONTROL NO. 1 and NO. 2, respectively, for controlling the volume in headphones referred to in (a) above.

b. Procedure.—The receiver may be operated for c. w., tone or voice reception. Volume level is controlled manually alone, or manually and automatically together. Selectivity may be controlled by the use of the crystal filter in all cases.

(1) *For c. w. reception.*—(a) Read paragraphs 23 and 24.

(b) For conditions requiring above average frequency stability, move the HEATERS OFF ON switch (BC-312 only) to the ON position 15 to 30 minutes prior to operation.

(c) Insert plugs for headsets P-19 in PHONES 2ND AUDIO jack, or PHONES 1ST AUDIO jack of the receiver; in PHONE NO. 1 and/or PHONE NO. 2 jack of the control box BC-321, if used. Insert plug for loudspeaker, if used, in SPEAKER 2ND AUDIO jack.

(d) Rotate BAND CHANGE switch to the position which covers the assigned frequency.

(e) Move the CW OSC OFF ON switch to the ON position.

(f) Move the CRYSTAL PHASING control to the OUT position.

(g) Move the SEND REC switch to the REC position if the receiver is not used in conjunction with the transmitter.

(h) Rotate the FREQUENCY or main tuning dial by means of the FAST TUNING control until the assigned frequency is indicated on the dial.

(i) Move the OFF MVC AVC control switch to the MVC position. Receiver output volume is manually controlled when the switch is in this position.

(j) After a brief period of time in which the receiver "warms up", rotate the ALIGN INPUT control until maximum noise is heard in the headset.

(k) If the signal is weak or slightly off frequency, use the VERNIER control for finer tuning. C. w., tone, or voice signals on the assigned frequency should now be distinguished. It may be necessary to tune on either side of the assigned frequency until the desired signal is located, and/or readjust the ALIGN INPUT control.

(l) The pitch of the signal may now be further adjusted to a desired note by the CW OSC ADJUST control. The use of the CW OSC ADJUST control permits a 4,000 cycle variation in the resultant beat note of the c. w. signal, but does not change the frequency adjustment or sensitivity of the receiver.

(m) The VOL control may be rotated at any stage of the tuning to adjust the output volume to a desired level. An increase in volume increases the sensitivity of the receiver. In tuning the receiver initially, it is preferable to maintain the volume fairly high. Volume is further adjusted by VOLUME CONTROL NO. 1 or NO. 2 on the control box BC-321 if the latter is used.

(n) An increase in selectivity of the receiver, if desired, may now be accomplished as prescribed in (4) below. It is inadvisable to employ automatic volume control when receiving c. w. or tone signals.

(2) *For tone or voice reception.*—Use the same procedure as prescribed for c. w. reception ((1) above) except place the CW OSC OFF ON switch in the OFF position as soon as the signal is tuned in.

(3) *For automatic volume control.*—Move the OFF MVC AVC switch to the AVC position. While this reduces the sensitivity of the

receiver, it tends to maintain the output at a constant level as determined by the VOL control setting. Automatic volume control is preferable where the voice signal fluctuates or otherwise tends to vary in output level.

(4) *For increased selectivity or rejection of interfering signal.*—Rotation of the CRYSTAL PHASING control from the OUT position in a counterclockwise direction increases the selectivity of the receiver. Careful adjustment of this control will permit of rejecting or minimizing an interfering signal on an adjacent channel without serious attenuation of the desired signal. Maximum selectivity is, in general, indicated by minimum background noise, and usually is established when the arrow on the CRYSTAL PHASING control is in the vertical position. The crystal filter is intended primarily for use in the reception of c. w. signals. It tends to cut off the sidebands of voice transmissions, but, depending on how far the CRYSTAL PHASING control is advanced, it frequently eliminates interference on adjacent channels without destroying the actual intelligibility of the voice signals. Its best use must be determined by trial.

c. To reduce engine ignition interference on the 1,500-3,000 kc. frequency bands.—(1) Follow the procedure prescribed in *b*(1) above, tuning on any frequency in the two frequency bands.

(2) Connect the signal antenna to the SIG ANT terminal. Disconnect the noise antenna. (The noise antenna consists of a piece of shielded wire connected between the source of interference and the NOISE ANT terminal on the receiver.) Adjust the NOISE ADJUST control to receive maximum noise output.

(3) Disconnect the signal antenna. Connect the noise antenna to the NOISE ANT terminal. Adjust the NOISE BALANCE control to receive maximum noise output. The noise output should be equal to that secured in (2) above. If the noise outputs are not equal, relocate the pick-up end of the noise antenna until they are equal, and readjust the NOISE BALANCE control for maximum noise output.

(4) Connect both antennas. Adjust both NOISE ADJUST and NOISE BALANCE controls until the minimum noise output is secured.

(5) If noise reduction is unsatisfactory, it may be necessary to move the pick-up end of the noise antenna a number of times, repeating the above procedure each time until the best results are obtained.

27. Care and adjustments.—*a. Inspections.*—To insure uninterrupted service, inspect the various components of each installation before and after each day's operation. Make a thorough inspection of each installation after every 50 hours of operation. For inspection instructions, see paragraph 33.

b. Preservation.—(1) At all times when the receiver, transmitter, or dynamotor unit are not in actual operation, place covers BG-75, BG-78, and BG-79 over these components, respectively. Close all slide fasteners. Securely fasten boxes and cases containing the transmitter tuning unit not in use, spare tubes, and other accessories at all times. Remove headsets, keys, and microphones when not in use, and put in a safe place. The antenna may or may not be disassembled, depending on its prospective use. If it is disassembled, insert mast sections in compartments of roll BG-56 and place the latter in a safe place. Screw a bolt provided for the purpose in the top of the mast base and strap cover BG-67 over the whole. To avoid injury due to shock or vibration of the vehicle when in motion, secure or pad all items of these sets which are not otherwise protected.

(2) Cover BG-84 is used on radio set SCR-193-D.

(3) The cabinet CH-60 protects radio set SCR-193-E.

c. Lubrication.—Components of these sets will be lubricated according to instructions outlined in paragraph 34.

d. Special adjustments.—See paragraph 35.

e. (1) In inclement weather.—Where there is a likelihood of exposure of the set components, cover these components as in *b* above. These sets may be operated with covers on. Slide fasteners on the covers of the receiver and transmitter are opened and the front flaps held up and back by snap fasteners during operation.

(2) Radio set SCR-193-E is not equipped for operation with the doors of cabinet CH-60 in place.

28. Storage.—*a.* If these sets are to remain out of service but within the vehicles for more than a few days, proceed as directed in paragraph 27*b*. Disassemble the antenna and cover the ends of the mast sections with petroleum jelly before placing in roll BG-56.

b. If set components are to be removed from the vehicle and stored elsewhere, handle them carefully, cover or wrap securely against dust, place in a dry, protected location, and safeguard against accidental injury. Inspect frequently for dust, rust, or injury, and clean and repair if necessary.

SECTION III

DETAILED FUNCTIONING OF PARTS

	Paragraph
Radio transmitters BC-191-A and BC-191-C, and transmitter tuning units TU-5-A and TU-6-A.....	29
Dynamotor units BD-77-A and BD-77-B.....	30
Radio receivers BC-312 and BC-312-C.....	31

29. Radio transmitters BC-191-A and BC-191-C, and transmitter tuning units TU-5-A and TU-6-A.—The transmitter,

together with either of the transmitter tuning units, contains the circuit elements for c. w., tone, or voice transmission. With transmitter tuning unit TU-5-A, the transmitter covers a frequency range of 1,500 to 3,000 kc. With transmitter tuning unit TU-6-A, it covers a range of 3,000 to 4,500 kc. During the explanation of the detailed functioning of the transmitter, it will be assumed that transmitter tuning unit TU-6-A is being used.

a. General circuit.—The circuits of radio transmitters BC-191-A and BC-191-C are for all practical purposes identical. The radio-frequency circuit is of the master oscillator, power amplifier type. The audio-frequency circuit consists of a push-pull modulator which is driven by an audio amplifier. The transmitter utilizes a tube VT-4-C for the oscillator, a tube VT-4-C for the power amplifier, two tubes VT-4-C in push-pull for the modulator, and a tube VT-25 for the audio amplifier (speech amplifier). (See figs. 17, 18, and 19.) For c. w. transmission, only the master oscillator, power amplifier, and speech amplifier tubes operate. For tone and voice transmission, all tubes operate. The power amplifier operates Class C; the modulator tubes in push-pull operate Class B; the audio amplifier driver tube operates Class A. Sufficient audio-frequency power is obtained from the modulator tubes for plate modulation of the power amplifier (tone or voice transmission). Side tone for monitoring purposes is supplied to the receiver from the speech amplifier during c. w., tone, and voice transmission.

b. Oscillator circuit.—The master oscillator circuit is schematically illustrated in figure 22. The oscillatory circuit by which the frequency of the transmitter is controlled is contained in the transmitter tuning unit TU-5-A or TU-6-A, as the case may be. When the transmitter tuning unit TU-6-A is employed and the BAND CHANGE SWITCH, A, is in position 2 (fig. 21), the oscillatory circuit comprises the tapped coil 601 and the variable capacitor 607. Moving the BAND CHANGE SWITCH to position 1 places the fixed capacitors 603 and 613 in parallel with the variable capacitor 607 and enables this tuning unit to cover the lower ranges of its frequency band. Continuous adjustment of frequency is accomplished by means of the variable capacitor 607, control B (fig. 22). Controls, coil, and capacitors of transmitter tuning unit TU-5-A (fig. 20) are arranged for similar operation on four bands, all of which are lower in frequency than those obtained with transmitter tuning unit TU-6-A. In each tuning unit, both coil and capacitors are thermally compensated to reduce frequency variation due to any change in ambient temperature. Subsequent discussion of the master oscillator circuit is limited to the circuit shown in figure 22, which results when transmitter tuning unit TU-6-A is

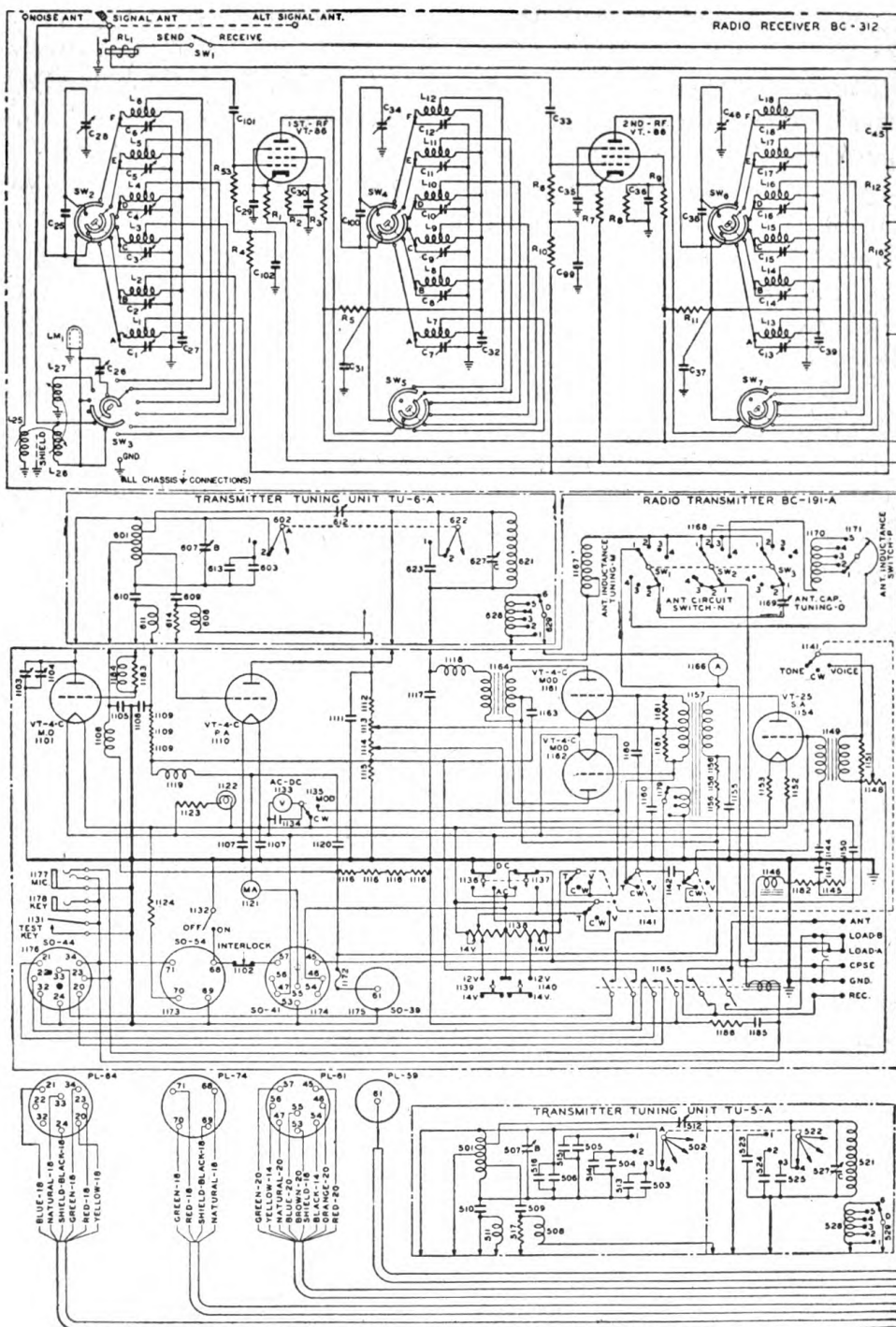


FIGURE 17.—Radio sets SCR-193-A and SCR-193-C, schematic diagram.

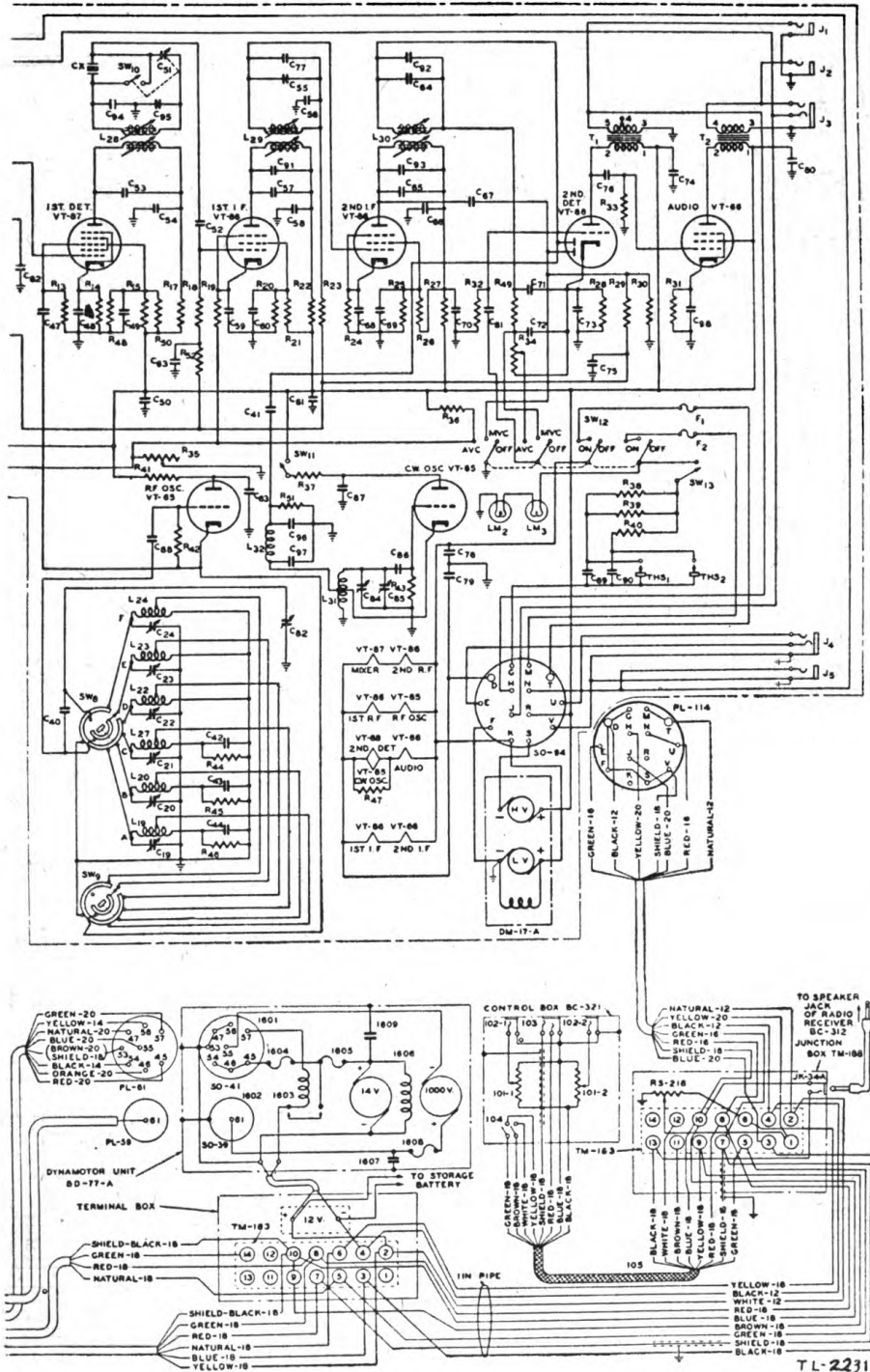


FIGURE 17.—Radio sets SCR-193-A and SCR-193-C, schematic diagram—Continued.

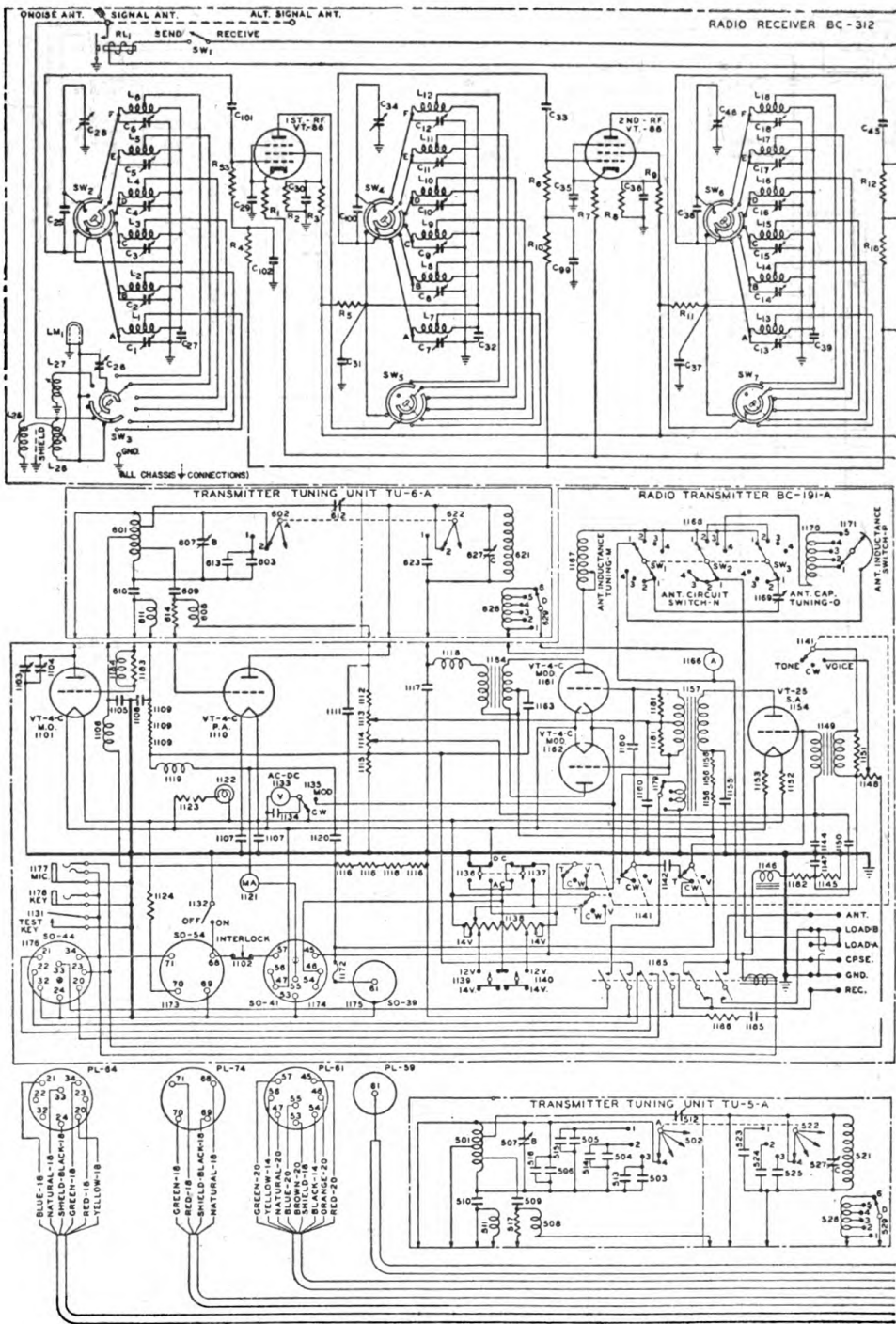


FIGURE 18.—Radio set SCR-B, schematic diagram.

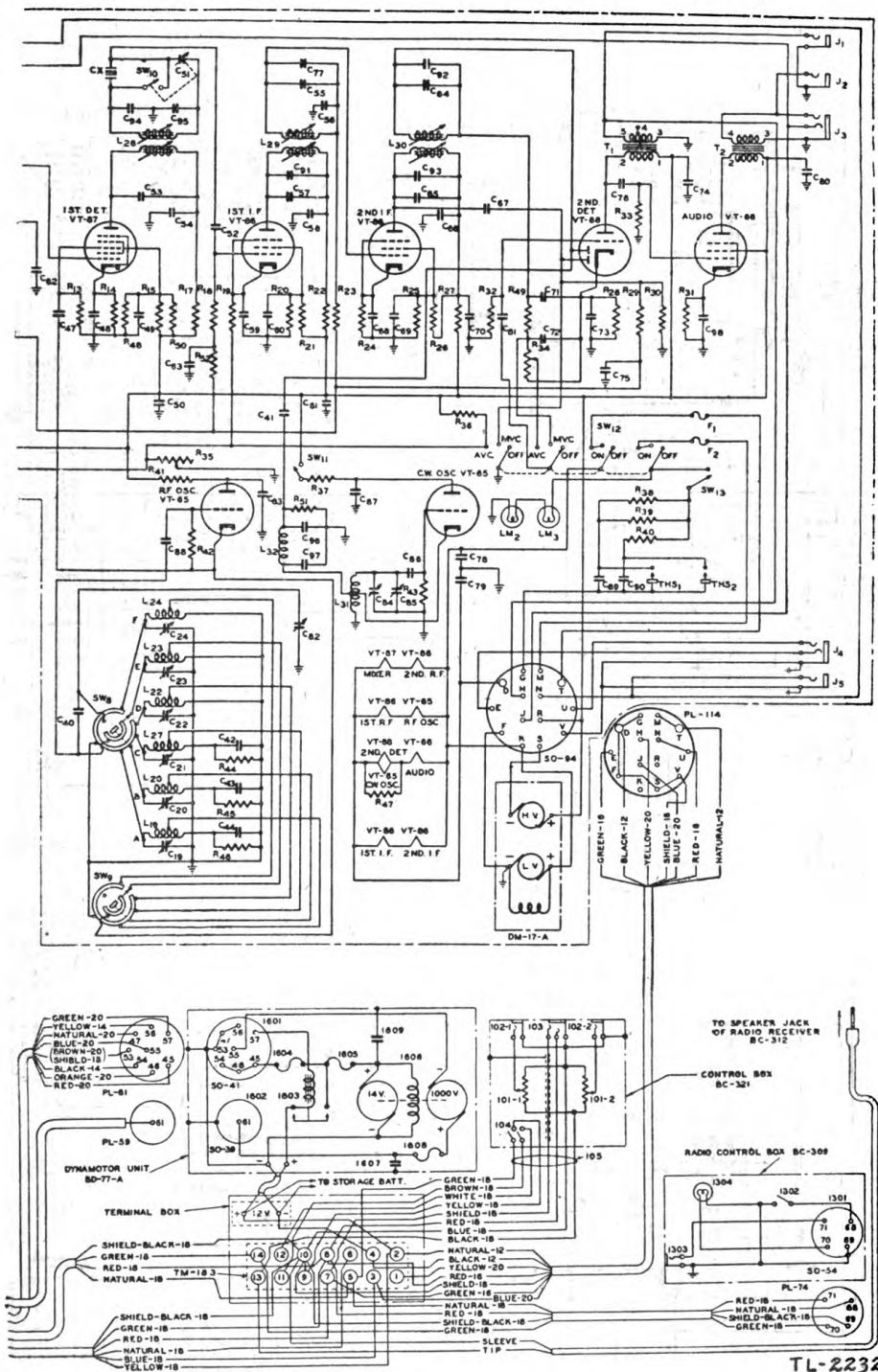


FIGURE 18.—Radio set SCR-193-B, schematic diagram—Continued.

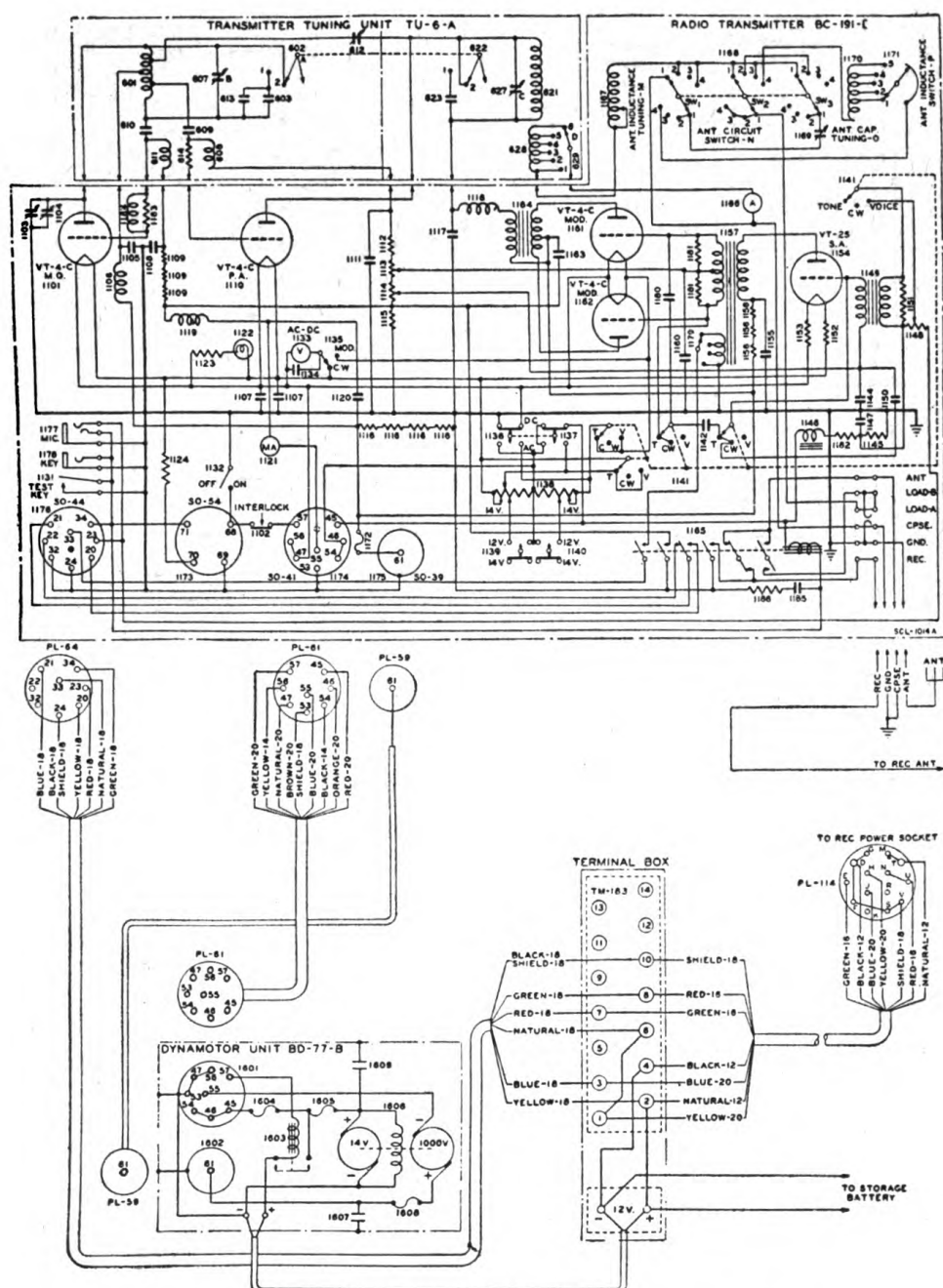


FIGURE 19.—Radio sets SCR-193-D and SCR-193-E, schematic diagram.

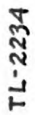
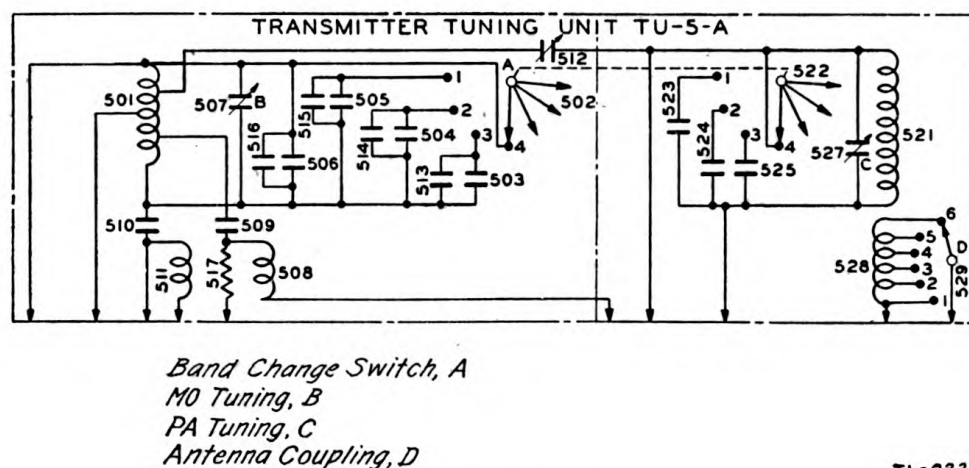


FIGURE 19.—Radio sets SCR-193-D and SCR-193-E, schematic diagram—Continued.

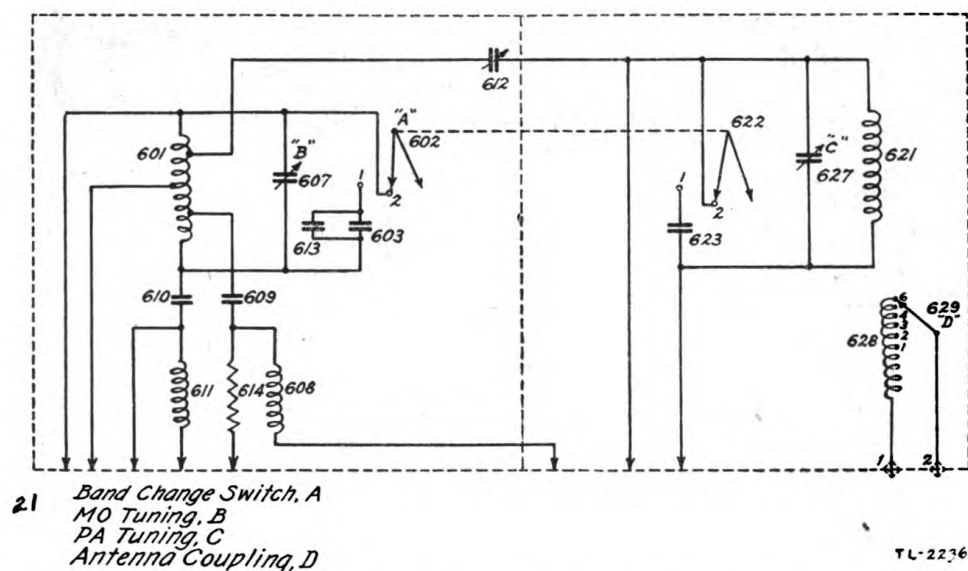
used and is set with the BAND CHANGE SWITCH on position 2. The radio-frequency voltage across the lower half of the coil 601 provides the master-oscillator grid-excitation voltage. The coil is also



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FIGURE 20.—Transmitter tuning unit TU-5-A, schematic diagram.

tapped an equal number of turns on either side of the center tap. The power amplifier grid-excitation voltage is furnished through capacitor 609. The master-oscillator grid-excitation voltage is



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FIGURE 21.—Transmitter tuning unit TU-6-A, schematic diagram.

obtained through capacitor 610, which blocks the plate voltage off the grid circuit. Resistor 1183 and choke 1184 in parallel are connected in series with the grid of the master-oscillator tube to prevent the

generation of parasitic oscillations. The plate voltage for the master-oscillator is fed to the tuning unit through radio frequency choke 1106, which, with capacitor 1105, prevents radio frequency current from flowing into the power supply. Resistor 1109 is the master-oscillator grid leak which provides the required operating bias for the master-

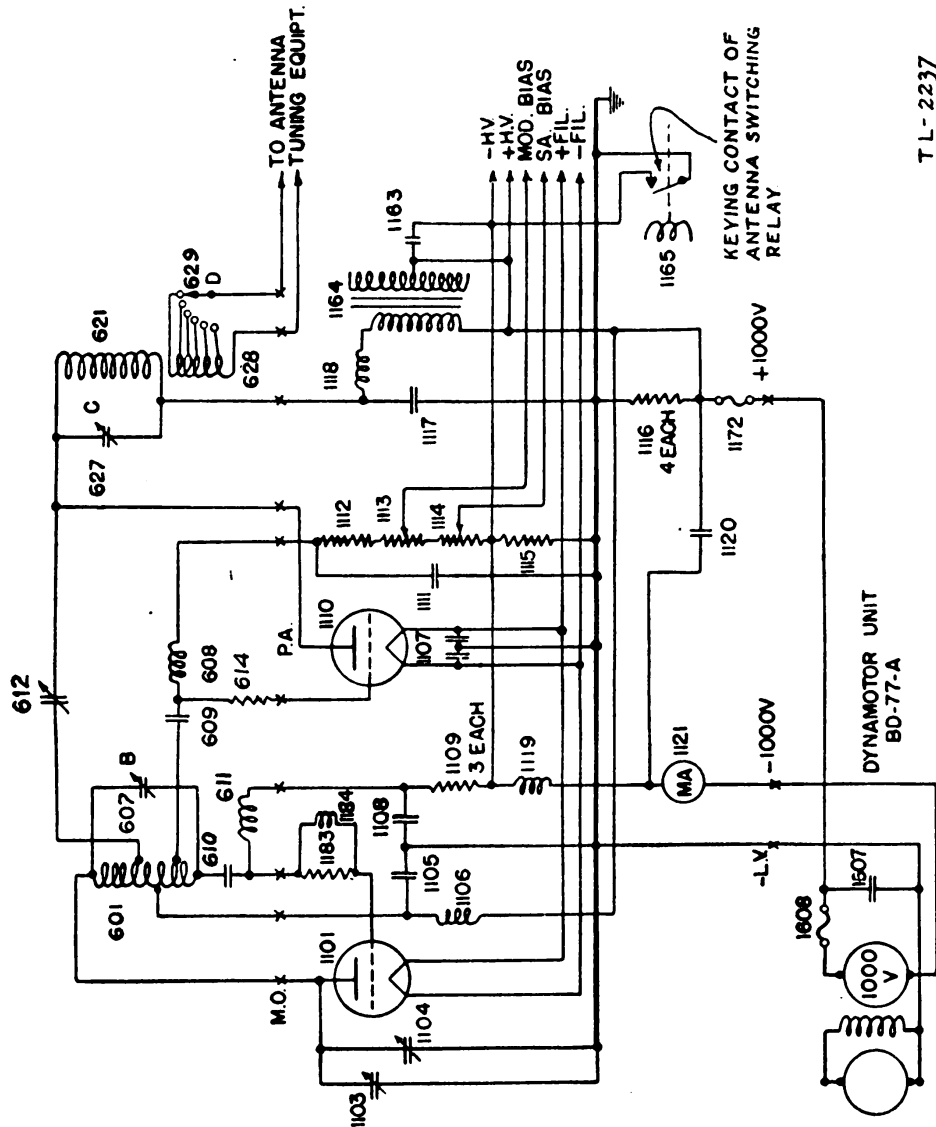


FIGURE 22.—Radio transmitters BC-191-A and BC-191-C, functional diagram of radio frequency and high-voltage circuits.

oscillator tube from the rectified grid current. Capacitor 1108 is a radio-frequency bypass capacitor. Grid choke 611, in conjunction with resistor 1109, serves as the necessary d. c. path from the grid to the filament, maintaining at the same time a high impedance to the radio-frequency grid excitation. Capacitor 1104 is the calibration reset by which the master-oscillator frequency can be adjusted to

correspond to the calibration whenever the oscillator tube is changed. This capacitor is adjusted through a small port in the front panel to the right of the TEST KEY. Capacitor 1103 is a sealed capacitor which provides the necessary thermal compensation for any frequency drift normally caused by warming up and variation of the ambient temperature of the oscillator tube.

c. Power amplifier circuit.—The power amplifier circuit is schematically illustrated in conjunction with the master oscillator circuit in figure 22. The power amplifier plate tank circuit, by means of which the plate load impedance is adjusted, is contained in transmitter tuning unit TU-5-A or TU-6-A, as the case may be. When the transmitter tuning unit TU-6-A is employed, and the BAND CHANGE SWITCH, A, is in position 2 (fig. 21), the plate tank circuit comprises the tapped coil 621 and variable capacitor 627. Moving the BAND CHANGE SWITCH to position 1 places the fixed capacitor 623 in parallel with the variable capacitor 627 and enables this tuning unit to cover the lower frequency range of the tuning unit. Continuous frequency adjustment of the plate tank circuit is accomplished by means of the variable capacitor 627, control C. Controls, coil, and capacitors of transmitter tuning unit TU-5-A (fig. 20) are arranged for similar operation on four bands, all of which are lower in frequency than those obtained with transmitter tuning unit TU-6-A. Subsequent discussion of the power amplifier circuit is limited to the circuit shown in figure 22, which results when the transmitter tuning unit TU-6-A is used and is set with the BAND CHANGE SWITCH on position 2. The power-amplifier grid receives excitation through capacitor 609 from the master-oscillator tank coil. Capacitor 609 also isolates the master-oscillator d.c. plate voltage from the power-amplifier grid. The power-amplifier grid bias is obtained from the flow of rectified grid current through resistors 614, 1112, 1113, and 1114. Choke 608 provides a low-impedance path for the d.c. grid current but a high-impedance path at radio frequency. Plate voltage for the power amplifier is applied through the modulation transformer 1164, the r.f. choke coil 1118, and the tank coil 621. The capacitor 1117, in conjunction with choke coil 1118, prevents r.f. currents from flowing into the power supply. The neutralizing capacitor 612 forms a part of a bridge circuit, including the power-amplifier grid-plate capacitance. Balancing this circuit by means of capacitor 612 prevents any interaction of the power amplifier on its grid-input circuit, thus eliminating the possibility of self-oscillation of the amplifier. All transmitter tuning units are properly neutralized at the time of manufacture and should never require adjustment in service unless

the setting is accidentally disturbed. The power amplifier is inductively coupled to the antenna circuit by means of a tapped inductor 628, the taps of which are selected by a panel-controlled, tapped

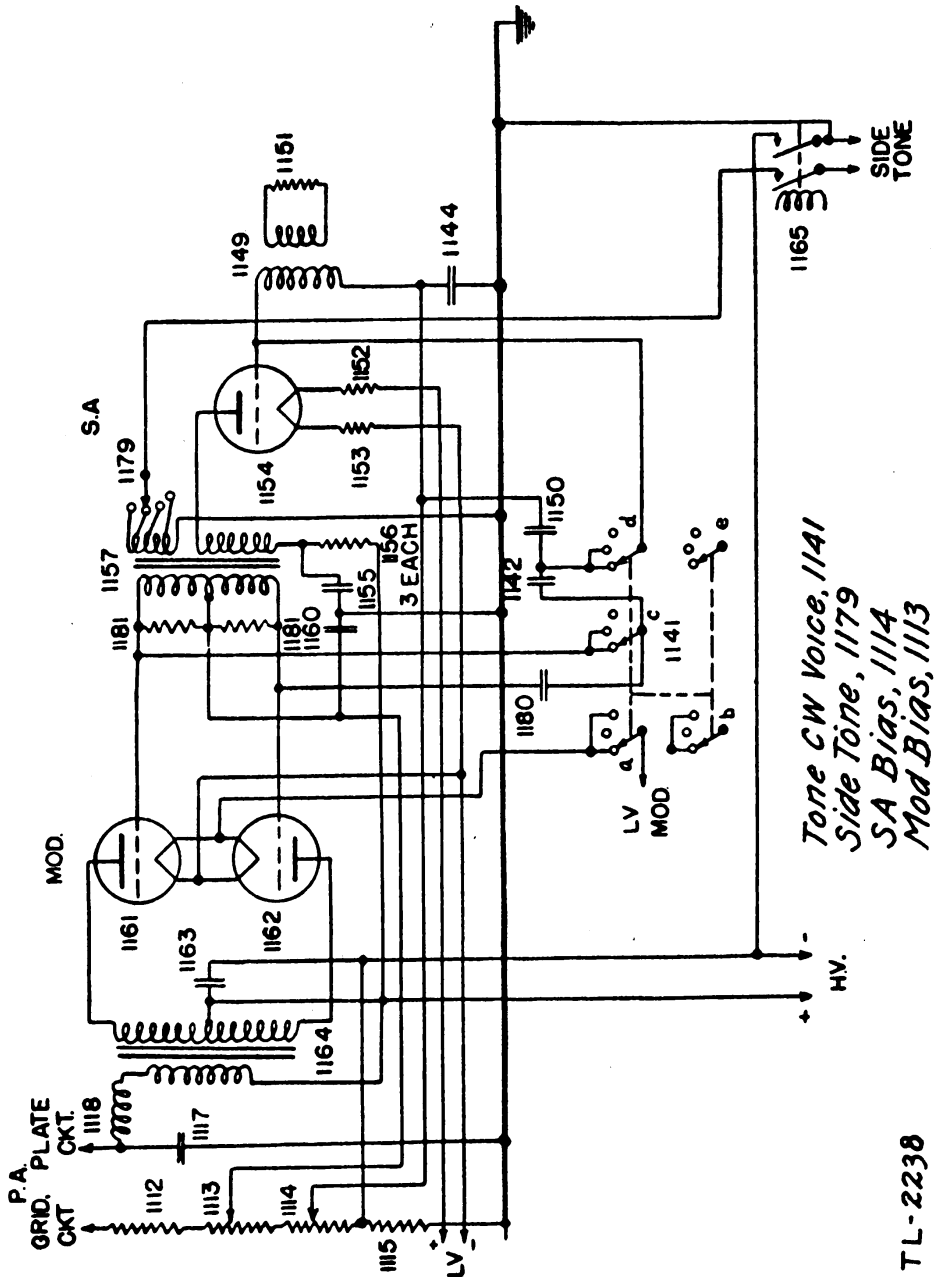


FIGURE 23.—Radio transmitters BC-191-A and BC-191-C, functional diagram of audio frequency circuits, tone operation.

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switch D. Sufficient variation in coupling is provided to allow operation into a wide range of antenna resistances.

d. *Modulation* (fig. 23).—Modulating voltage is applied to the plate circuit of the power amplifier by means of the modulation transformer

1164. The modulator tubes 1161 and 1162 are operated in a push-pull, class B circuit in which they are biased nearly to cut-off. The modulator tubes receive excitation from the speech amplifier tube

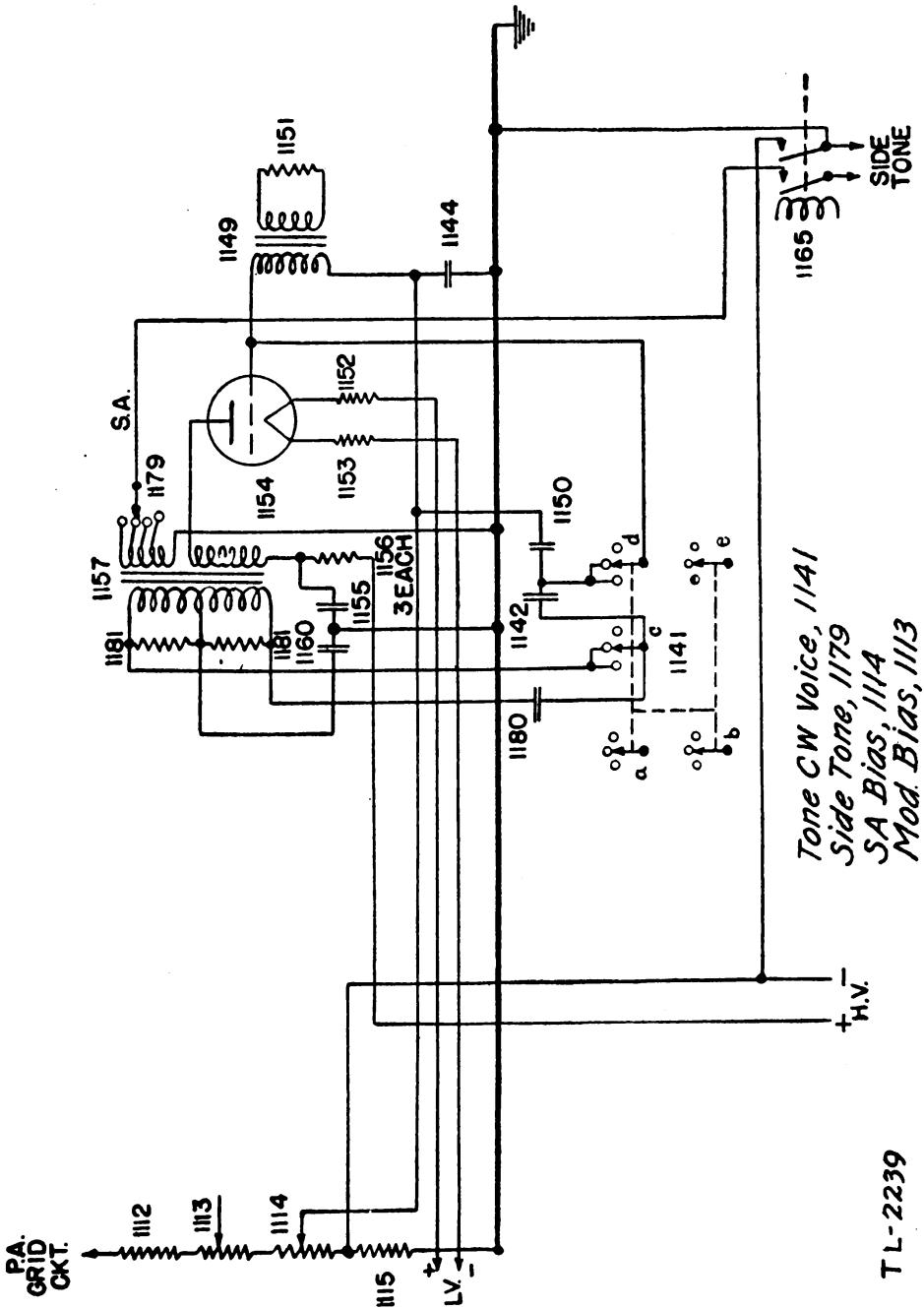


FIGURE 24. — Radio transmitters BC-191-A and BC-191-C, functional diagram of audio frequency circuits c. w. operation, side tone.

1154, through an interstage transformer 1157. The secondary of this transformer is loaded by resistors 1181 to reduce the effective load variation caused by the modulator grid current. Plate power

for the speech amplifier is obtained from the positive high voltage through resistor 1156 which limits it to the proper value. Capacitor 1155 serves as an audio frequency bypass for this power source. Receiver side tone for monitoring the transmitted signal is provided by a tapped winding on the interstage transformer 1157. Switch 1179 selects the proper tap on this transformer winding to give the proper side tone level.

e. Tone, c. w., and voice operation.—(1) The TONE CW VOICE switch, 1141 (fig. 25), serves to select the desired type of transmission. It performs the following functions:

- (a) It controls the modulator filaments.
- (b) It controls a line compensating section of the filament resistor 1138 (fig. 26).
- (c) It controls the tone-oscillator feed-back circuit.
- (d) It connects the microphone circuit to the input transformer 1149 for VOICE operation.

(2) With switch 1141 in the TONE position (fig. 23), capacitor 1142 feeds energy from the speech amplifier plate to its grid in the proper phase relation to cause oscillation at an audio rate, and thus the required tone voltage is generated. The secondaries of input transformer 1149 and interstage transformer 1157 are resonated by capacitors 1150 and 1180, respectively, to provide the required tuned circuits in both grid and plate circuits of the a. f. oscillator (speech-amplifier on voice). The tuning of these circuits is such as to establish a frequency of oscillation of about 1,000 c. p. s. Resistor 1151 on the primary of input transformer 1149 serves to stabilize the grid excitation of the speech-amplifier tube. The modulator tubes receive their excitation from transformer 1157.

(3) For c. w. operation (fig. 24), switch 1141 shuts off the modulator tubes by removing the filament power. The speech amplifier functions the same as for tone operation, although it furnishes only the audio frequency signal for monitoring the c. w. transmission.

(4) For voice operation (fig. 25), switch 1141 disconnects the tone capacitors 1142, 1150, and 1180, connects the microphone circuit to the primary of the input transformer 1149, and makes the modulator tubes operative by connecting their filaments to the supply. Potentiometer 1148 is the input level control. The speech amplifier will then receive its excitation from the microphone by means of input transformer 1149. The transmission is monitored through the receiver side tone circuit.

f. Bias voltages.—Bias for the modulator tubes is obtained from resistor 1113, and bias for the speech amplifier from resistor 1114 (fig. 23). These resistors form a part of the power-amplifier grid

leak, the voltage across them resulting from the rectified grid current of the power amplifier. Capacitors 1144 and 1160 serve to bypass the speech amplifier and modulator bias, respectively, at audio fre-

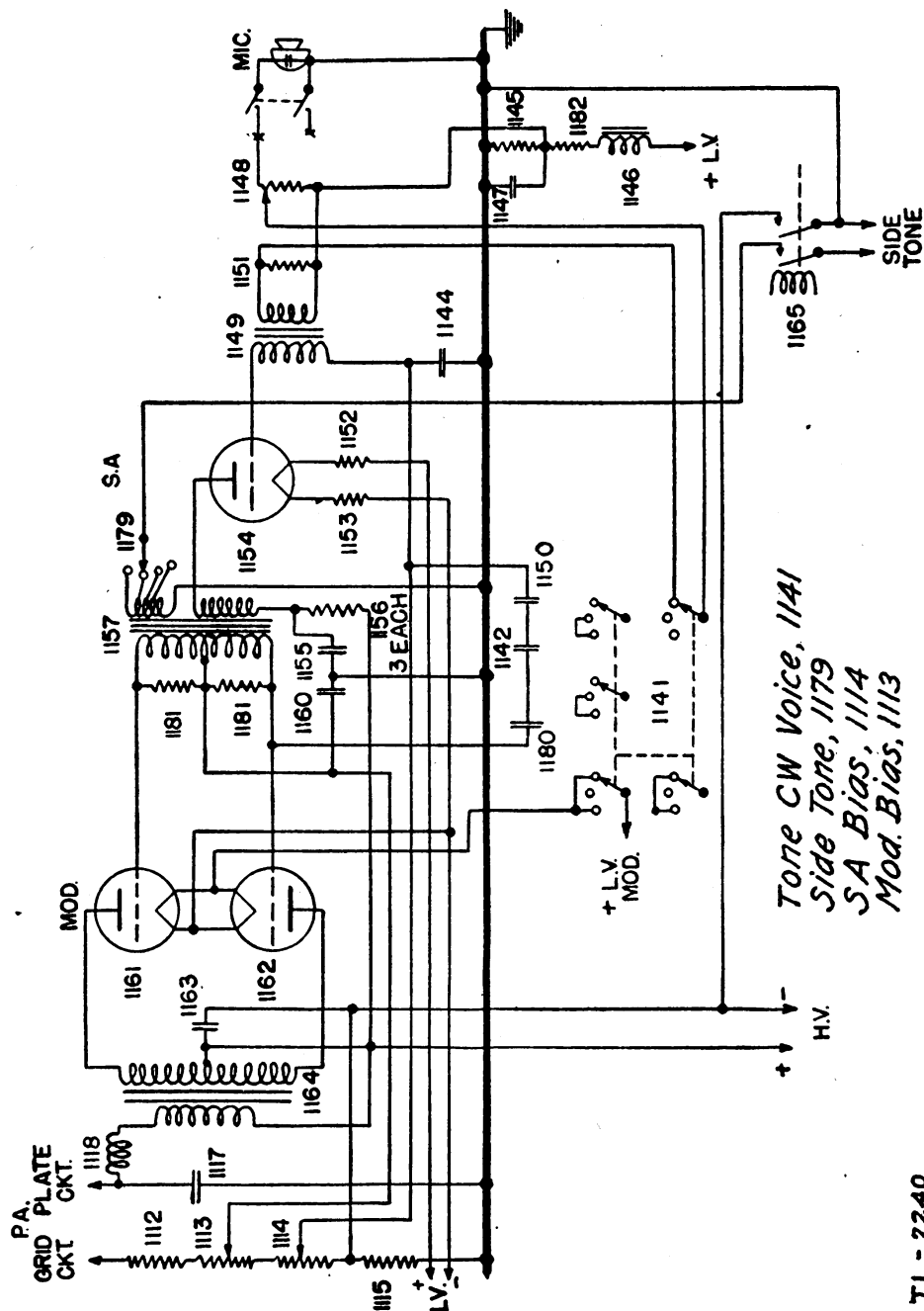
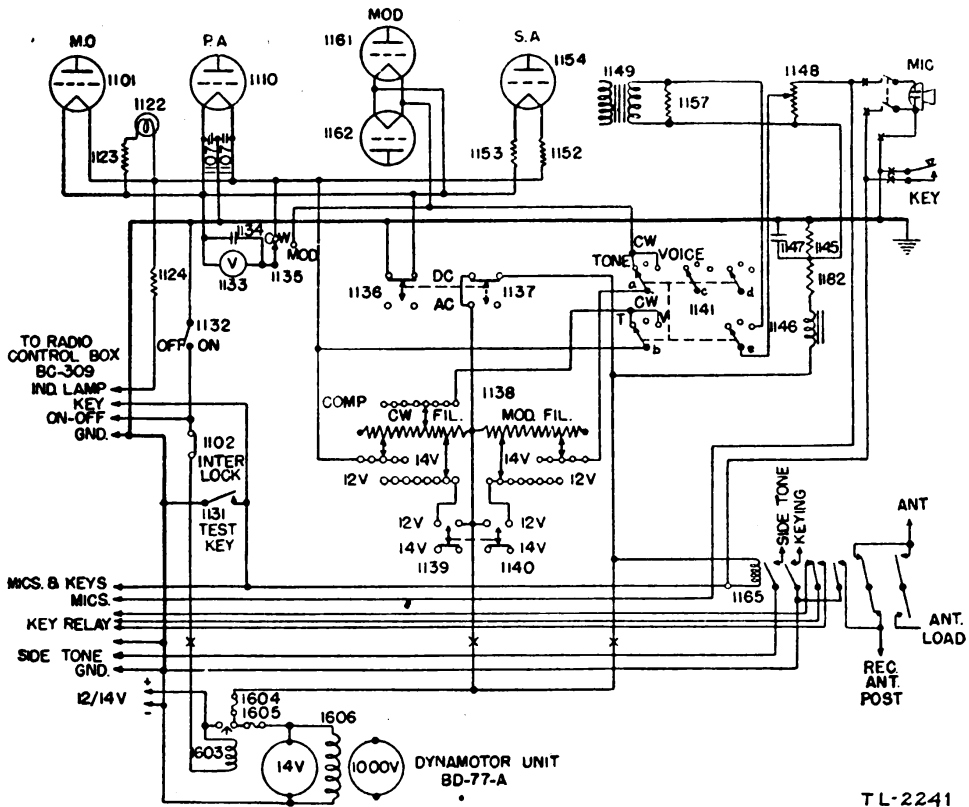


FIGURE 25.—Radio transmitters BC-191-A and BC-191-C, functional diagram of audio frequency circuits, voice operation.

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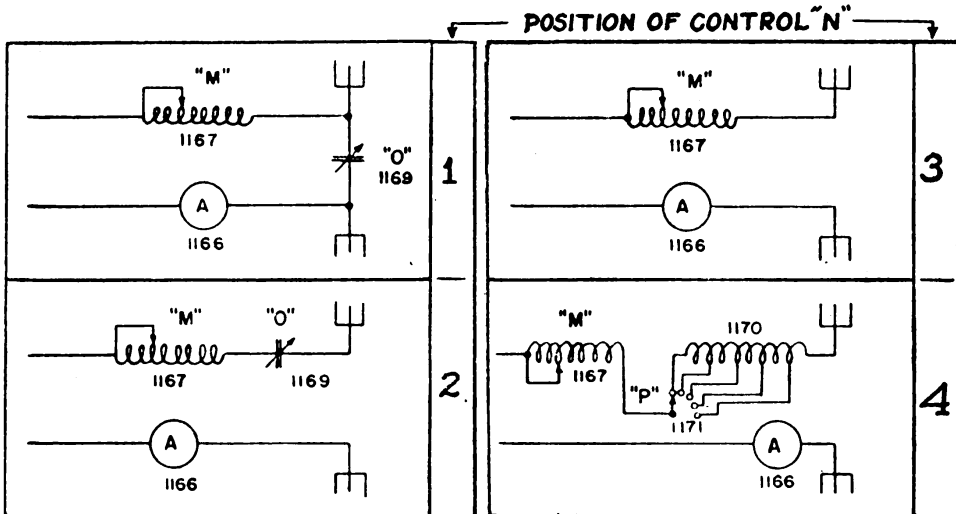
quency. Both the modulator bias control (labeled MOD BIAS), and the speech amplifier control (labeled S. A. BIAS), are accessible in the tube compartment. The speech-amplifier grid bias is usually

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FIGURE 26.—Radio transmitters BC-191-A and BC-191-C, functional diagram of low-voltage and control circuits, d. c. operation.



Ant. Ind. Tuning, M
Ant. Circuit Switch, N
Ant. Cap. Tuning, O
Ant. Ind. Switch, P
Ant. Current, 1166

TL-2242

FIGURE 27.—Radio transmitters BC-191-A and BC-191-C, functional diagram of antenna tuning equipment.

adjusted at the time of manufacture, and its value is not particularly critical.

g. Keying.—Keying of the transmitter (fig. 22) is controlled by means of resistor 1115, one end of which is connected to the negative high voltage and all grid circuit returns, and the other end to filament or ground potential. The keying contacts of relay 1165 are connected across this resistor. When the keying contacts are open, the grids of the tubes are biased beyond cut off, and oscillation is stopped. When these keying contacts are closed, resistor 1115 is shorted and normal grid biases on all tubes are reestablished. Operation of the keying contacts is accomplished by supplying power to the antenna switching relay 1165. (See fig. 26.) Power is supplied to this relay when the key, test key, or the microphone keying button or switch is operated. Operation of the antenna switching relay performs the following additional functions:

- (1) Disconnects the receiver from the antenna and grounds the receiver input circuit.

- (2) Connects the transmitter to the antenna circuit.

- (3) Keys the side tone circuit.

h. Filament circuit.—The transmitter is so designed that it may be operated from an a. c. source in connection with a power-supply unit consisting of a high-voltage rectifier for plate supply, a low-voltage rectifier for the control units, and a transformer to furnish a. c. filament supply. The AC DC switch 1136-1137 (figs. 3, 17, and 26) performs the circuit changes to allow the transmitter to be operated from either source. In the a. c. position the filament circuit is separated from the control circuit, and the normally grounded side of the filament is disconnected from ground. Capacitors 1107 (fig. 26) then serve to maintain the tube filaments at ground potential with respect to radio frequency currents. Under the condition of d. c. filament supply, resistor 1138 is used to adjust the filament potential to 10 volts, as indicated by the red line on voltmeter 1133. The midtap of this resistor is connected to the power source. One side of the resistor is used for the adjustment of the filaments of the tubes used for c. w. operation and the other side for the modulator tubes. Provision is made to short out a section of the c. w. filament resistor by means of switch 1141 ((b), fig. 26) to compensate for the increased line drop which occurs when the modulator filaments are lighted. This arrangement makes it necessary to readjust the voltages when changing from c. w. to tone or voice. A portion of the resistor may be short circuited by the 12V 14.2B switch 1139, 1140 (figs. 3 and 26), so that the correct filament voltage may be applied both when the power-supply storage battery is being charged and when

not being charged. Switch 1135 connects filament voltmeter 1133 to either the c. w. or modulator filaments. If the filaments are operated from an a. c. source resistor 1138 serves simply as a compensating resistor to eliminate the need for readjusting the filament rheostat when changing from c. w. to modulated transmission.

i. Antenna tuning equipment.—(1) The antenna tuning equipment on the transmitter is capable of tuning practically any antenna to frequencies between 1,500 to 4,500 kc. Inductive and capacitive loading, and series and parallel tuning are provided. The selection of a suitable tuning circuit and its subsequent tuning are readily accomplished by observation of the antenna current meter and the total plate current meter. The latter meter by its sharp dip at resonance indicates most exactly the point of resonance. In the case of the vehicular installations described herein, the antenna is comprised of mast base MP-37, and antenna mast sections MP-49 to MP-53, inclusive. This antenna, when operated on a frequency between 1,500 and 4,500 kc., radiates most effectively with inductive series tuning.

(2) The types of loading and tuning desired are selected by means of the following controls located on the right front of the transmitter (see figs. 3 and 27):

(a) The meter marked ANT CURRENT is the radio frequency meter 1166, which indicates the r. f. currents in the various networks of the antenna tuning equipment.

(b) The dial marked ANT IND TUNING, M, is the control for the continuously variable loading inductor 1167, and is so calibrated that the inductance included is proportional to the dial reading.

(c) The switch marked ANT CIRCUIT SWITCH, N, is the control by means of which any one of the four antenna tuning networks is selected. The numbered positions on the switch correspond to the circuits as numbered in figure 27.

(d) The dial marked ANT CAP TUNING, O, is the control by means of which the capacitor 1169 is varied, and is so calibrated that the capacity included is proportional to the dial readings.

(e) The switch marked ANT IND SWITCH, P, is the control for the tapped inductor 1170, and is so constructed that the higher numbered positions correspond to the greatest amount of included fixed inductance.

(f) The switch marked ANT COUPLING SWITCH, D, 629 (fig. 21) located on the transmitter tuning unit is the control for the antenna coupling coil of the transmitter tuning unit and is used to control the coupling from the power amplifier circuits to the antenna tuning equipment and antenna. It is so constructed that the percentage of coupling is proportional to the number of the switch position.

(3) The antenna tuning networks (fig. 27) are selected and adjusted as follows:

Caution.—Set the control D (2)(f) above) at 1 before beginning any antenna tuning operations.

(a) With the control N on position 1, the transmitter works in to a resonant circuit, in which the high voltage built up across the antenna tuning capacitor is used to “voltage feed” the antenna. This circuit is generally used for high frequencies and fairly long antennas and is seldom used in tuning the standard vehicular antennas. The antenna feed circuit is maintained at resonance by means of control M, while the voltage fed to the antenna is varied by means of the control O, and resonance is indicated by the ANT CURRENT meter. The current in the feed circuit is adjusted by the control D and should not exceed 6 amperes. The step-by-step tuning procedure is as follows:

1. The control O is set at some arbitrary scale reading.
2. The circuit is resonated by means of the control M for a maximum reading on the antenna current meter.
3. The control D is adjusted so that the antenna current reads slightly below 6 amperes.
4. The circuit is reresonated as in 2 above.
5. The above procedure is repeated until the proper power amplifier loading is indicated on the total plate current meter (200 to 220 ma. on c. w.). Under the same conditions of power amplifier load, the lower the dial reading on the control M and the lower the reading on the antenna current meter, the more power will actually be delivered to the antenna.

(b) With control N on position 2, the transmitter works into a series resonant circuit. The antenna is “current fed.” The antenna circuit is resonated by means of controls M and O. Resonance is indicated by a maximum reading on the ANT CURRENT meter. The circuit is used generally for operation near the fundamental frequency of an antenna and therefore is not particularly efficient for tuning the standard vehicular antenna. When this tuning network is selected, the value of capacity should be the maximum for which an inductance value can be found that will give resonance. (This will be a minimum inductance value.)

(c) With control N in position 3, the transmitter works in to a series resonant circuit providing “current feed” and inductive loading. This circuit is used for operation below the fundamental frequency of the antenna and is generally used when tuning the standard antenna,

operating on the higher frequency assignments for these installations.

1. The antenna circuit is resonated by means of the continuously variable inductor controlled by M.
2. Resonance is indicated by the dip in the total plate current and the indication of current on the antenna circuit meter.
3. Having found resonance, the transmitter is loaded by advancing control D until the proper plate current is indicated on the total plate current meter (200 to 220 ma. on c. w.).

(d) With the control N on position 4, the antenna circuit is identical with that obtained on position 3 except that an additional inductor controlled by P is added in series with the variable inductor 1167. This circuit is used when the operating frequency is relatively far below the fundamental frequency of the antenna, as will be the case when these installations and the standard antenna are operated on frequency assignment of 1,500 kc. and somewhat above. The adjustment of this circuit is accomplished as follows:

1. Control D is set on 1.
2. Control P is set on 1.
3. Inductor control M is rotated through its limits, while the total plate current meter is watched for any indication of a resonance (sharp dip). If resonance is found, the transmitter is loaded to its proper value.
4. Should resonance not be found at this setting of P, successively advance P to higher values, and repeat the variation of control M for each position of P until resonance is found.

(e) The change in antenna circuit constants, as a result of tuning, reflects into the tank circuit of the power amplifier. This necessitates a retuning of the power amplifier. The tuning of an antenna is not complete until the power amplifier and antenna circuits are both resonated to the transmitter frequency. Under some conditions (see par. 21e) it may be possible to resonate an antenna on either position 3 or 4 of control N. Operation on position 3 of control N is used when there is a choice.

j. *Remote operation* (fig. 18).—Radio control box BC-309 provides means for turning the transmitter off and on and for connecting the transmitter key. It merely parallels identical controls on the transmitter. Control box BC-321 may be used to turn the transmitter off and on and to connect the microphone. It also parallels identical controls on the transmitter proper. Remote operation of the transmitter may be accomplished at the location of these control boxes. Radio control box BC-309 contains, in addition to the OFF ON switch 1302, a key jack 1303, a pilot light 1304, and a socket 1301.

Control box BC-321 contains, in addition to the OFF ON switch and the microphone jack, two headset jacks and two potentiometers, providing individual control for the two headsets. The connection of cord CD-297 from terminals 10 and 13 of the terminal box to the control box BC-321 supplies audio output from the receiver to the control box.

30. Dynamotor units BD-77-A and BD-77-B (fig. 9).—*a.* Dynamotor units BD-77-A and BD-77-B provide the high voltage plate supply for radio transmitters BC-191-A and BC-191-C, respectively. Each consists of a dynamotor on top of which is mounted the relay fuse box containing the starting relay, fuses, and filter elements. The unit is rated 14 volts—40 amperes input, 1,000 volts—0.35 ampere output, at 5,000 r. p. m. with 55° C. rise, for one-half hour intermittent duty. Dynamotors BD-77-A and BD-77-B are substantially identical in external appearances and mounting details, and BD-77-B is more conservatively rated at the values given above than is BD-77-A.

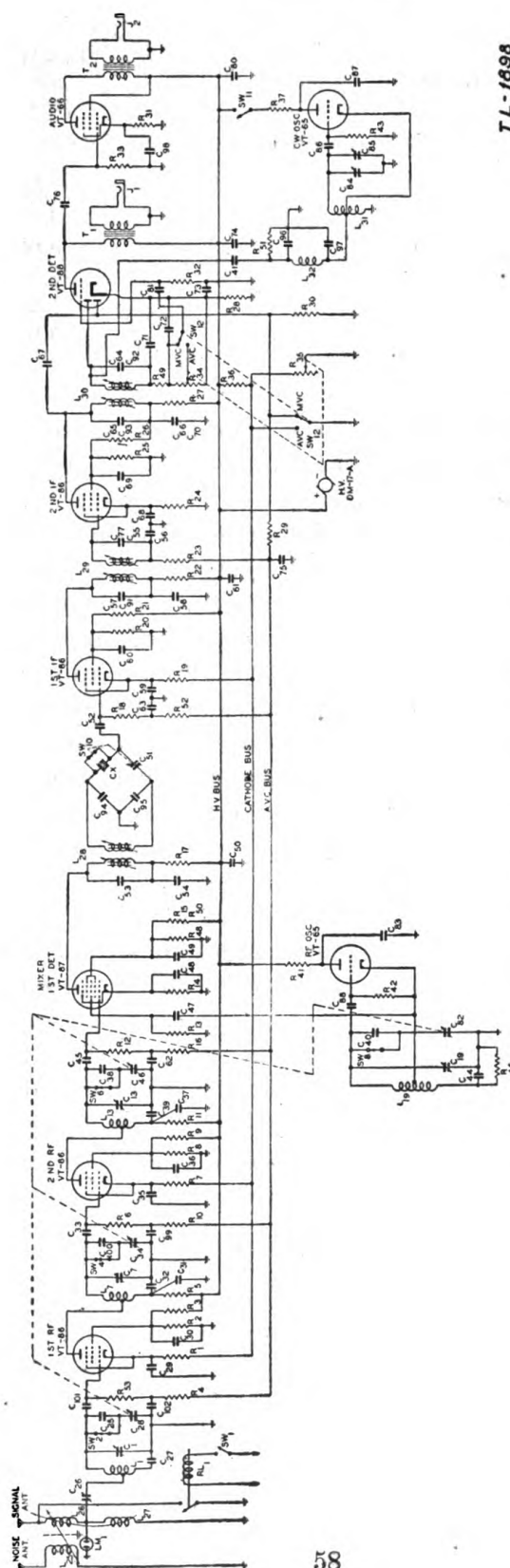
b. The dynamotor has a double armature winding consisting of a low-voltage (12-volt motor) winding and a high-voltage (1,000-volt generator) winding. Each winding terminates at a commutator on either end of the armature. The windings are carefully insulated from each other. The field is common to both motor and generator windings and is excited from the 12-volt storage battery supply. Skeleton-type bearing brackets on each end afford maximum accessibility of the commutator and brushes. The external leads of the dynamotor go directly into the relay fuse box through two bushings in the top of the magnet frame.

c. Within the relay fuse box (fig. 10) is mounted a molded terminal board. On this terminal board are mounted the starting relay, low-voltage and high-voltage fuses, and the elements of the filter circuit. A totally inclosed solenoid type starting relay is used. A spare high-voltage fuse, spare fuse link, and a socket wrench are carried in clips inside the cover of the relay fuse box. In one end of the relay fuse box are mounted sockets SO-39 and SO-41. A $\frac{1}{8}$ -inch diameter hole for entrance of a conduit containing the two power input leads is provided between these sockets.

31. Radio receivers BC-312 and BC-312-C.—Radio receivers BC-312 and BC-312-C are practically identical and are of the multi-band, integral coil, superheterodyne type, and employ metal tubes throughout. Specific differences are pointed out as various elements of the circuits are discussed. Unless specifically referred to a particular type receiver, the discussion herein applies equally to each. Provision is made for the reception of c. w., tone, or voice signals over the frequency range of 1,500 to 18,000 kc., in six steps as follows:

Band	Frequency cover- age excluding overlap, kc.
A.....	1,500 to 3,000
B.....	3,000 to 5,000
C.....	5,000 to 8,000
D.....	8,000 to 11,000
E.....	11,000 to 14,000
F.....	14,000 to 18,000

a. General circuit.—Figure 28 is a functional circuit diagram of radio receiver BC-312 showing the connections set up by the band change switch to receive a signal in one particular frequency band. In this functional diagram the band change switch itself, and all coils and capacitors not essential to the operation on that band, are omitted for the sake of simplicity. Radio receivers BC-312 and BC-312-C employ two stages of pentode radio frequency amplification, a pentagrid mixer and separate triode radio frequency oscillator, two stages of pentode intermediate frequency amplification, a duo-diode-triode which performs the functions of a diode detector and one stage of audio frequency amplification, and a separate stage of pentode audio frequency amplification. The separate triode oscillator is provided to produce a beat note for c. w. reception. The antenna circuit of the receiver provides a means of transferring the desired signal to the first radio frequency stage, and also provides a means of transferring local noise to the first stage on bands A and B phased in such a manner that the total noise is materially reduced below that normally picked up on the antenna. The two radio frequency stages provide selectivity and also act to reduce possible interference from signals occurring at either the intermediate frequency or at the so-called repeat point, or image frequency. The mixer tube circuit with its associated oscillator adds to the selectivity of the receiver, and also changes the frequency of the signal from the frequency received to that at which the intermediate frequency amplifier is tuned. The intermediate frequency stages provide additional selectivity and gain. The second detector stage demodulates the amplified signal to audibility. The audio frequency stages provide additional amplification. The c. w. oscillator, operating at a frequency slightly different from that to which the intermediate frequency stages are tuned, provides an audible beat frequency adjustable in pitch when receiving c. w. signals.



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FIGURE 28.—Radio receiver BC-312, functional diagram, manual volume control operation.

b. Antenna circuit (figs. 28 and 31).—The antenna circuit is coupled to the tank coil of the first radio frequency stage (L_1) through capacitor C_{26} . L_{25} , L_{26} , and L_{27} are inductances added to the circuit to permit canceling out locally generated noise normally received on the signal antenna. In addition, coil L_{27} serves as a radio frequency choke between the antenna and ground. The functioning of this noise suppression circuit is described in detail in *k* below. Capacitor C_{26} , controlled by the knob on the front panel marked ALIGN INPUT, in conjunction with changes in connections of L_{25} , L_{26} , and L_{27} produced by the band change switch, permits tuning the antenna circuit to resonance to an incoming signal. LM_1 is a neon lamp which normally has a very high resistance. When a certain threshold voltage is exceeded, the lamp becomes a conductor by ionization and prevents further rise in voltage, bypassing the current to ground. It is used in this circuit to protect the receiver from any excessive voltages which might be applied to the antenna.

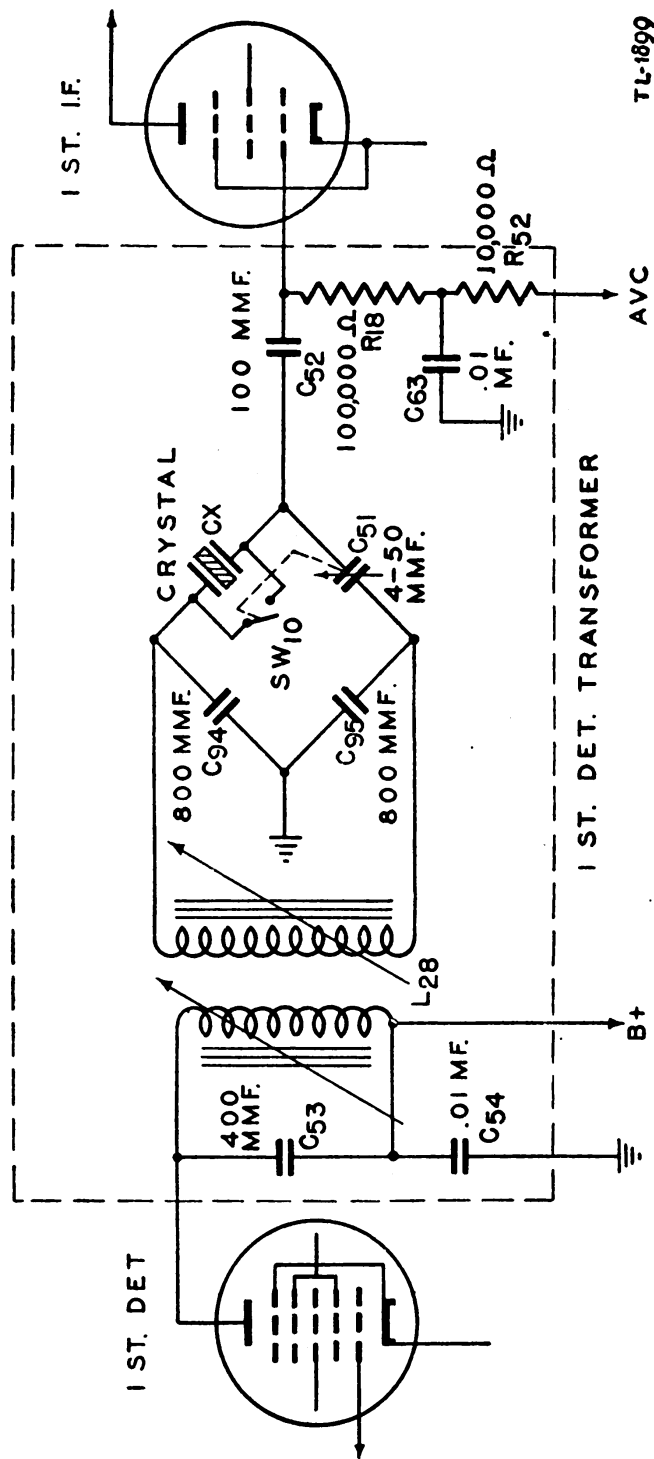
c. Radio frequency (fig. 28).—The circuits of the first radio frequency, second radio frequency, and mixer stages are very nearly identical. They are so designed to permit tuning with a single control gang capacitor. The screen voltages for the first radio frequency, second radio frequency, and mixer tubes are provided by voltage dividers connected between plus plate voltage and ground. R_2 and R_3 ; R_8 and R_9 ; and R_{48} , R_{15} , and R_{50} form these voltage dividers. The screen grids are bypassed to ground across these voltage dividers by capacitors C_{30} , C_{36} , and C_{49} , respectively. Cathode bias for the first radio frequency and second radio frequency tubes is partly fixed and partly variable. The fixed portion of this bias is secured by the drop across R_1 and R_7 , respectively, and from the junction of these resistors to the variable bias at the voltage divider formed by R_{36} and adjustable resistor R_{35} . R_{35} is shorted to ground for automatic volume control (a. v. c.) operation and in this mode of operation the cathode biases of these tubes are secured entirely by the drop across R_1 and R_7 . The cathode bias of the mixer tube is secured by the drop across R_{14} . The injector grid return is through resistor R_{13} . C_{29} , C_{35} , and C_{48} are bypasses to ground across the cathode biasing resistors. C_{33} and C_{45} keep the plate voltages from the preceding tubes from reaching the grids of the second radio frequency and mixer tubes, respectively. C_{101} in the first radio frequency stage is used to make the grid circuit of this stage identical with those of the two succeeding stages to permit the gang tuning referred to above. L_1 , L_7 , and L_{13} are the tank inductances of the grid circuits of the first radio frequency, second radio frequency, and mixer stages, respectively. The plate circuits of the first radio frequency and second radio frequency

tubes are conductively coupled to the tank inductances of the next succeeding stages. These tank inductances are tuned by a gang capacitor consisting of C_{28} , C_{34} , and C_{46} . In series with the sections of this gang capacitor are three capacitors, C_{25} , C_{100} , and C_{38} , across which is placed a gang control switch SW_2 , SW_4 , and SW_6 (operating with the band change mechanism). This gang control switch permits these series capacitors to be used in the three higher frequency bands to obtain a greater frequency spread on the dial, and shorts these capacitors in the three lower frequency bands. Trimmer capacitors C_1 , C_7 , and C_{13} , are provided to permit individual preadjustment (alignment) of the three circuits involved to resonance at a given input frequency with one setting of the gang tuning capacitor. C_{32} and C_{39} serve as radio frequency bypass capacitors and in conjunction with R_5 and R_{11} , respectively, isolate the d. c. plate supply from radio frequency currents. As blocking condensers, they prevent the shorting of the plate supply of the first and second radio frequency tubes to ground. C_{27} in the first radio frequency stage is placed in the circuit to make the latter identical to those of the second radio frequency and mixer stages for purposes of gang tuning. C_{102} , C_{99} , and C_{62} act as bypass capacitors for a. v. c. operation. R_4 and R_{53} ; R_8 and R_{10} ; R_{12} and R_{16} provide a high impedance d. c. grid return for the tubes involved and also provide a path through which a. v. c. voltages are applied. The grid return of these three stages is made through resistor R_{29} to ground for m. v. c. operation and through R_{29} and R_{30} for a. v. c. operation. The purpose of R_{30} is explained in detail in *j* below. R_5 , R_{11} , and R_{17} are in series with the plate leads of the tubes involved, and with capacitors C_{31} , C_{37} , and C_{54} , in conjunction with C_{50} , serve to reduce to a negligible value the amount of radio frequency reflected back into the power supply circuit from these tubes.

d. Radio frequency oscillator (fig. 28).—The radio frequency oscillator employs a modified Hartley circuit with the plate end of the tank circuit operating at ground potential for radio frequencies. The tank circuit of this oscillator consists of inductance L_{19} , which is tuned by C_{82} . C_{82} is ganged with the main tuning capacitors C_{28} , C_{34} ; and C_{46} , C_{40} , in series with C_{82} , is used in the three higher frequency bands to obtain greater frequency spread, but is shorted out by switch SW_8 in the three lower frequency bands. Switch SW_8 is ganged with switches SW_2 , SW_4 , and SW_6 . C_{19} is a trimmer capacitor which adjusts the tracking of the oscillator stage with the other tunable stages of the receiver. C_{42} , C_{43} , and C_{44} (see figs. 17, 18, and 19), while not essential to the functioning of the oscillator circuit, are included in the tank circuit to make it suitable for tracking in all bands with those of the radio frequency and mixer stages. C_{88} serves as a grid-blocking capac-

itor and R_{42} as a grid-bias resistor. R_{41} and R_{46} together serve to reduce the plate voltage supplied by the dynamotor to the proper value for this tube. R_{44} , R_{45} , and R_{46} are different for the different frequency bands of the receiver to insure that the plate voltage on the oscillator tube will be correct in each band. The radio frequency plate circuit of the oscillator is completed through C_{83} and ground to the tank circuit. The radio frequency voltage occurring between the cathode of the oscillator tube and ground is impressed on the injector grid of the mixer tube (1st detector) through C_{47} . The action of the mixer and oscillator on the received signal produces an output signal of 470 kc., having the same modulation as the signal received in the antenna. The intermediate frequency amplifier is tuned to 470 kc.

e. Crystal filter (figs. 28 and 29).—The output of the mixer stage is inductively coupled to the grid circuit of the first intermediate frequency stage through transformer L_{28} . C_{53} , in parallel with the primary of this transformer, forms a resonant circuit which is tuned to 470 kc. by varying the position of an iron core within the transformer coil. The secondary of this transformer and both coils of transformers L_{29} and L_{30} are tuned in a similar manner. In the grid side of transformer L_{28} , there is a bridge circuit consisting of capacitors C_{94} , C_{95} , and C_{51} and crystal CX. This crystal is provided with a shorting switch SW_{10} . With this switch closed, the secondary of L_{28} and capacitors C_{94} and C_{95} form a resonant circuit tuned to the intermediate frequency so that one-half of the available voltage across the secondary of inductance L_{28} is impressed on the grid of the first intermediate frequency tube through blocking capacitor C_{52} . When switch SW_{10} is open (by turning the CRYSTAL PHASING control from the OUT position), the signal is impressed on the grid of the first intermediate frequency tube through crystal CX and through capacitor C_{52} . Crystal CX is cut to the intermediate frequency of 470 kc. CX behaves as a sharply tuned resonant circuit and offers a high impedance to all frequencies, except its resonant frequency. The capacity of the crystal holder would normally serve as a bypass to this resonant circuit, reducing its impedance. For this reason, the bridge circuit consisting of capacitors C_{94} , C_{95} , and C_{51} permits balancing out the effect of the capacity of the crystal holder and raises the impedance of the circuit to frequencies other than the resonant frequency. Any other adjustment of capacitor C_{51} provides a bypass around the crystal and reduces the circuit impedance to undesired signals. This control is referred to as the CRYSTAL PHASING control since the crystal, neglecting the effects of the holder, behaves as a resonant circuit with the current and voltage very nearly in phase. Introducing



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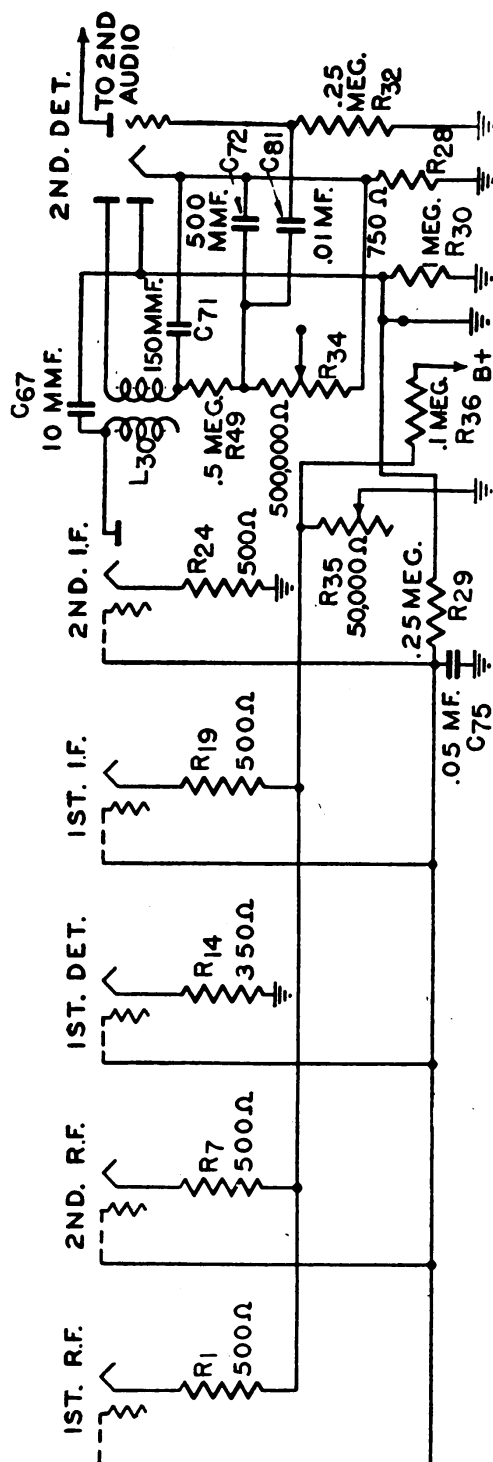
FIGURE 20.—Radio receiver BC-312, functional diagram, crystal selectivity filter operation.

a capacitance disturbs this condition of resonance and introduces a phase difference between the current and voltage, the magnitude of which is determined by the degree of unbalance.

f. Intermediate frequency amplifier (fig. 28).—Resistor R_{18} provides a high impedance direct current grid return for the first intermediate frequency tube, and in series with R_{52} provides for the introduction of a. v. c. voltage. C_{63} is a radio frequency bypass to ground shunting radio frequency out of the a. v. c. circuit. The coupling between first and second intermediate frequency stages, and between the second intermediate frequency stage and the second detector, is inductive through transformers L_{29} and L_{30} . Both sides of both of these transformers form circuits which are resonant to the intermediate frequency, the necessary capacitance being provided by C_{57} and C_{91} ; C_{77} and C_{55} ; C_{65} and C_{93} ; C_{64} and C_{92} . C_{77} , C_{91} , C_{92} , and C_{93} are not used in BC-312-C. The necessary tuning to secure resonance is achieved through the use of movable iron cores in the same manner as in transformer L_{28} . The resistor R_{19} has the same voltage divider system as for the first and second radio frequency tubes. The cathode bias for the second intermediate frequency tube is obtained through resistor R_{24} . The grid return of the second intermediate frequency tube is through resistor R_{23} , which provides means for introducing a. v. c. voltage, and with capacitor C_{56} prevents radio frequency from feeding into the a. v. c. circuit. The screen voltages of these two tubes are obtained from the voltage dividers consisting of R_{20} and R_{21} , and R_{25} and R_{26} . These screen grids are bypassed to ground by capacitors C_{60} and C_{69} , respectively. C_{59} and C_{68} serve to bypass the cathodes to ground.

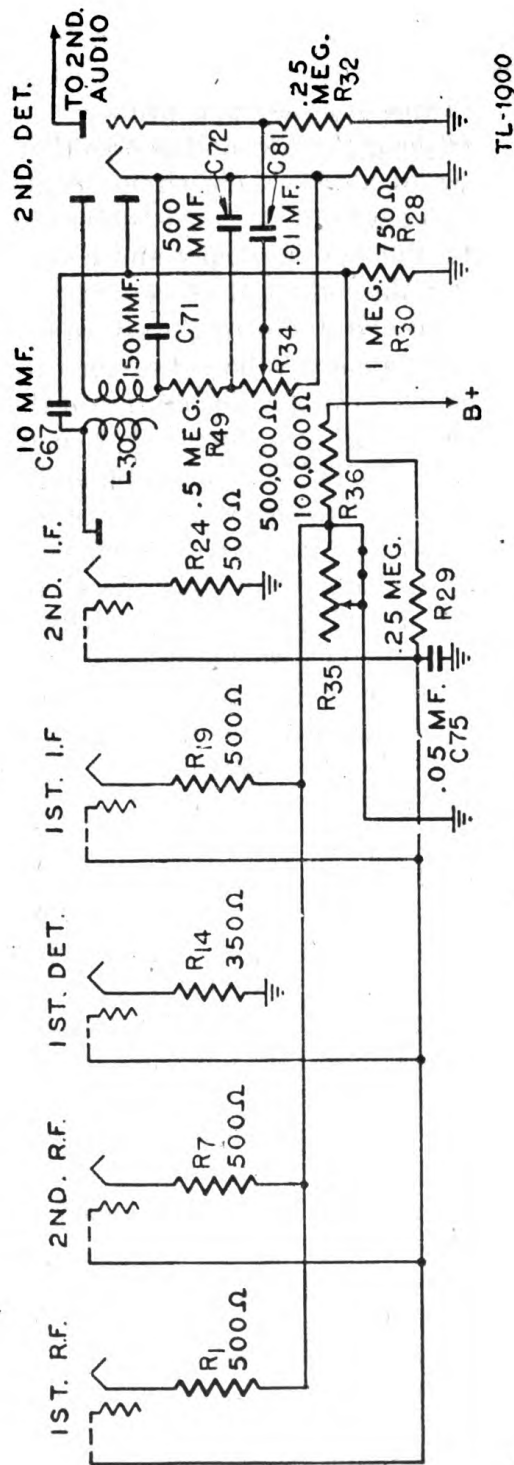
g. Second detector (figs. 28 and 30).—A duo-diode-triode is employed as a second detector, one diode circuit actually serving for purposes of demodulation, the other diode circuit providing for a. v. c. action. The triode portion of the tube serves as the first audio frequency amplifier. These two latter functions will be described in detail in subparagraphs below. The cathode and the detector diode plate (fig. 28) act as a half-wave rectifier so that any current flowing through resistors R_{49} and R_{34} is pulsating. Any portion of the drop across these resistors may be amplified as audio frequency. C_{71} and C_{72} are placed in the circuit as radio frequency bypasses across these resistors. R_{23} provides the proper cathode bias for this tube and is bypassed to ground by C_{73} .

h. Audio frequency amplifier (figs. 28 and 30).—The triode portion of the detector tube serves as the amplifying tube for the first stage of audio frequency. This tube receives its grid excitation through capacitor C_{81} . This excitation consists of the drop across the entire



① Manual volume control.

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③ Automatic volume control.

FIGURE 30.—Radio receiver BC-312, functional diagram.

resistor R_{34} for m. v. c. operation and the drop across the lower portion of resistor R_{34} for a. v. c. operation. R_{32} serves as a high impedance d. c. grid return for the tube. The output circuit of the first audio frequency tube is coupled to the control grid of the second audio frequency tube through capacitor C_{76} . The primary of transformer T_1 acts as an impedance coupling element and also as the primary of the transformer for coupling to a secondary circuit containing J_1 , into which phones may be plugged. C_{74} in this circuit prevents audio frequency feedback into the power supply and completes the audio frequency plate circuit for this tube. R_{33} serves as a high impedance d. c. grid return for the second audio frequency tube. The cathode bias of the second audio frequency tube is provided by R_{31} , which is bypassed to ground by capacitor C_{98} . The output of the second audio frequency tube is coupled through transformer T_2 to jack J_2 , into which phones may be plugged, and to J_3 (see figs. 17, 18, and 19), into which a loud speaker may be plugged. In the case of the receiver BC-312-C, a 12 volt field supply is available in the connections of the jack J_3 for those speakers requiring the same, providing the speaker is properly corded to the transmitter. Cording data is supplied with the speaker. C_{80} in this plate circuit prevents audio frequency feedback into the power supply and completes the audio frequency plate circuit.

i. *C. w. oscillator* (fig. 28).—A modified Hartley circuit is employed operating with the plate end of the tank circuit at ground potential for radio frequency. The tank circuit of this oscillator consists of coil L_{31} tuned by capacitors C_{84} and C_{85} in parallel. C_{86} is a grid-blocking capacitor and R_{43} is a grid-return resistor. The plate supply of this oscillator is obtained through switch SW_{11} (CW OSC ON OFF switch) which permits turning this oscillator on or off at will. R_{37} , in series with the d. c. plate circuit, serves to drop the plate voltage from that supplied by the dynamotor to the correct value for this tube. The radio frequency plate circuit is completed through capacitor C_{87} and ground to the tank circuit. A portion of the drop across tank coil L_{31} is impressed on the plate end of the second detector tank circuit through a low-pass filter consisting of C_{96} , C_{97} , R_{51} , and L_{32} and through coupling capacitor C_{41} . The purpose of this filter is to prevent the introduction of harmonics of the c. w. oscillator frequency into the detector circuit of the receiver.

j. *Volume control*.—(1) *Manual volume control action* (figs. 28 and 30①).—When operating on manual volume control (MVC), the cathodes of the first and second radio frequency tubes and the first intermediate frequency tube are returned to the voltage divider consisting of R_{35} and R_{36} . This voltage divider is located between plus plate voltage and ground, so that changing the value of the resistor R_{35}

by operating the VOL control on the front panel changes this cathode bias and thus varies the gain of these tubes. R_{30} is shorted, preventing a. v. c. action described in (2) below. In this mode of operation, that portion of the audio frequency signal which appears across all of resistor R_{34} is available at the input of the first audio frequency tube.

(2) *Automatic volume control action* (figs. 28 and 30②).—For automatic volume control (a. v. c.) operation, resistor R_{35} is short circuited to ground. The audio frequency voltage available at the grid of the first audio frequency tube is now the voltage across that portion of R_{34} between ground and the sliding contact of resistor R_{34} . Changing the position of this contact by operation of the VOL control on the front panel changes the amount of audio frequency voltage impressed on the first audio frequency tube without interfering with a. v. c. operation. The second diode plate of the second detector tube is coupled to the plate tank circuit of the second intermediate frequency stage through capacitor C_{67} to generate the a. v. c. supply voltage. A rectifier circuit exists between this plate resistor R_{30} to ground, thence through resistor R_{28} to the cathode. The cathode is maintained at a positive potential with respect to the a. v. c. plate by d. c. plate current in the triode section of the tube flowing through R_{28} . Rectification will take place in this a. v. c. circuit when the peak value of the a. c. voltage impressed is greater than the d. c. drop across resistor R_{28} , and this rectified voltage will appear across resistor R_{30} . The magnitude of the voltage across R_{30} is therefore dependent upon the strength of the signal received in excess of the drop across resistor R_{28} . Thus no a. v. c. action is obtained on signals whose a. c. peak value is less than the drop across resistor R_{28} . This type of action is referred to as "delayed" a. v. c. In a. v. c. operation, the control grids of the first radio frequency, second radio frequency mixer, first intermediate frequency, and second intermediate frequency are returned to ground through resistor R_{30} . A change in the voltage across resistor R_{30} therefore affects the bias and gain of these tubes. The circuit is designed to bias these tubes more negatively on a strong signal, thus reducing their gain and tending to maintain a constant input to the detector.

k. *Noise suppression circuit* (figs. 28 and 31).—(1) A circuit is provided for the purpose of reducing interference on bands A and B caused by poorly shielded engine ignition systems. Three inductance coils L_{25} , L_{26} , and L_{27} function when properly adjusted to reduce this type of interference. L_{25} is coupled to L_{26} , an electrostatic shield being provided to insure that this coupling is entirely magnetic. This coupling is also adjustable. The coupling between L_{26} and L_{27} is primarily electrostatic, the necessary magnetic shield being provided to insure

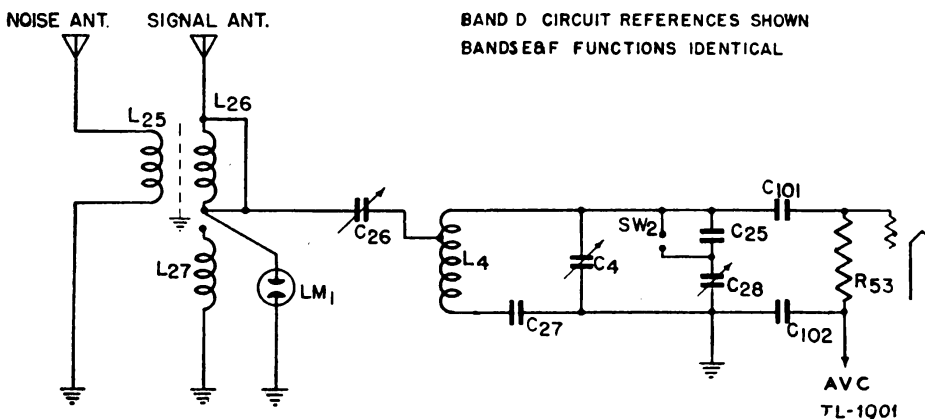
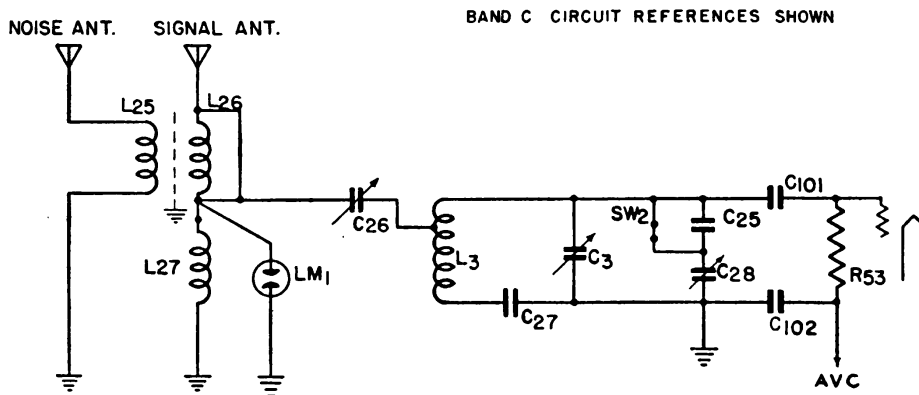
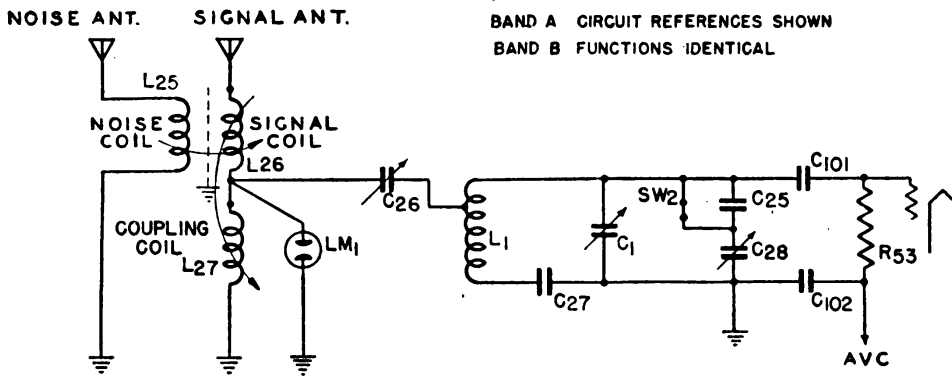


FIG. 31.—Radio receiver BC-312, functional diagram of antenna circuits.

that this type of coupling is secured. The coupling between L_{26} and L_{27} is also adjustable. A knob on the front panel marked NOISE BALANCE controls the coupling between L_{26} and L_{25} and serves to adjust the amount of noise introduced into the receiver circuits from the noise antenna. The coupling between L_{27} and L_{2A} , and controlled

by the NOISE ADJUST control, determines the phase relation of the resultant noise voltage introduced into the receiver. The coupling between L_{25} and L_{26} is adjusted to produce minimum noise (not necessarily zero). L_{27} is then varied to reduce the noise to zero, thereby insuring that the phase of the noise fed by the separate antennas results in cancelation.

(2) In radio receiver BC-312-C, screws and locknuts are used to adjust the controls marked NOISE ADJUST and NOISE BALANCE.

l. Tube heater circuits.—Metal tubes of the heater type are employed in radio receiver BC-312. These tubes require a heater voltage of approximately 6 volts per tube. To permit operation on a 12-volt

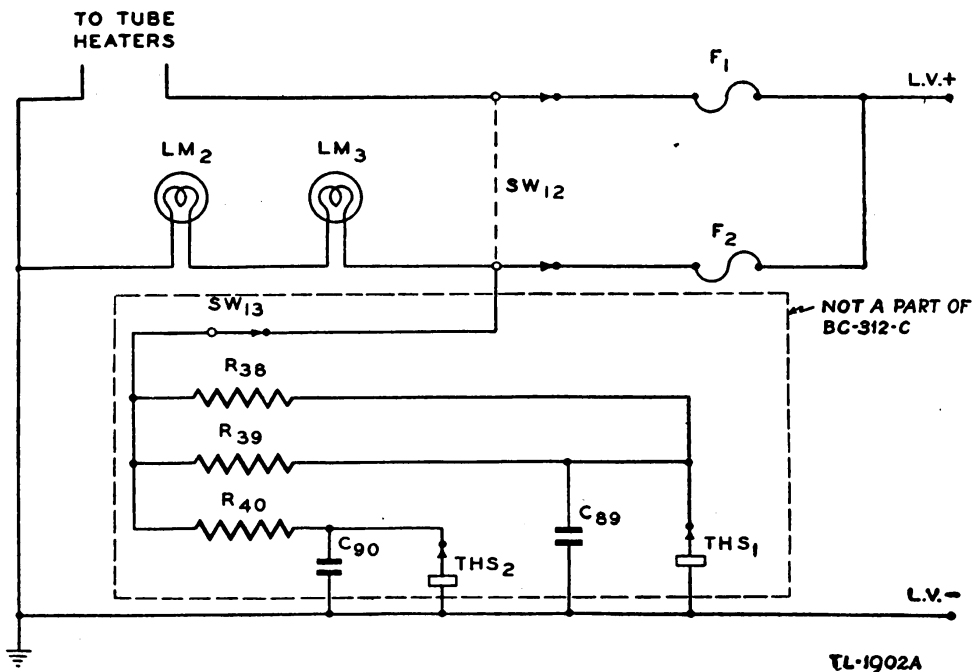


FIG. 32.—Radio receivers BC-312 and BC-312-C, functional diagram of low-voltage circuits.

power supply system, these tubes are connected in a series-parallel combination, with two tubes which require the same heater current connected in series, and then these pairs arranged in parallel. Tube heaters are bypassed by C_{78} and C_{79} . Actual heater connections are shown in figures 17, 18, and 19.

m. Oscillator compartment heater circuit (BC-312 only) (fig. 32).—In order to maintain the radio frequency oscillator at a constant frequency for a given setting of its tuning capacitor, the entire circuit is installed in a heat-insulated compartment. The use of electric heaters and thermostats maintains this compartment at a constant temperature of 110° F. R_{38} , R_{39} , and R_{40} are the heater elements for

this chamber, the first two being connected in parallel and controlled by the temperature control THS_1 . R_{40} is cut out and into the circuit by temperature control THS_2 . In series with this combination is the switch SW_{13} (HEATERS OFF ON switch) which permits the heater circuits to be manually controlled. C_{89} and C_{90} are connected across the contacts of temperature controls THS_1 and THS_2 , respectively, to reduce interference caused by the opening and closing of the contacts. The two temperature controls are adjusted to open at 109° F. and 111° F., respectively. These values have been selected so that the temperature of 110° F. is maintained with the minimum number of temperature control contact breaks. Of the total heater capacity (49 watts with 14 volts input), 33 watts are used between 109° F. and 111° F., and 49 watts at 109° F. and below. When the temperature rises above 109° F., only 33 watts are applied to the compartment. At and above 111° F., no heat is supplied. On the reverse cycle, as the temperature falls below 111° F., 33 watts are applied, slowing down the rate of temperature fall until 109° F. is reached, at which time 49 watts are applied. A fuse marked HEATERS, accessible on the front panel, protects the heater circuit.

n. Dial lamp circuit (figs. 19 and 32.)—Two dial lamps $LM-27$ (circuit symbols LM_2 and LM_3) are connected in series across the heater circuit in such a manner as to receive current through the heater fuse and be turned off and on by the OFF MVC AVC switch (BC-312). In radio receiver BC-312-C the dial lamps are connected in series and controlled by the OFF MVC AVC switch. The fuse marked LAMPS (circuit symbol F_2) on the front panel protects this circuit.

o. The SEND REC switch.—The SEND REC switch controls the operation of a relay that shorts the input network of the receivers BC-312 and BC-312-C to ground at such times as the SEND REC switch is turned to SEND and the transmitter is keyed. At such times as no transmissions are intended, the SEND REC switch will be turned to the REC position. The purpose of the relay shorting function is to keep at a minimum the voltages built up in the receiver circuits when the high energy signals from the transmitter are radiated in close proximity to a receiver of the sensitivity of the BC-312 type.

p. Dynamotor DM-17-A and DM-21-B (figs. 33, 34, and 35).—Dynamotor DM-17-A, operating on an input voltage of 12 to 14 volts, produces the necessary plate voltage for the receiver BC-312. This dynamotor is secured to the underside of the chassis of the receiver. Under full load conditions, the dynamotor requires 2.7 amperes at 14 volts d. c., with an output of approximately 82 milliamperes at 230 volts d. c. (See fig. 33.) L_1 and C_1 constitute a filter

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circuit to prevent radiation of radio frequency interference into the low-voltage supply circuit. L_2 , L_3 , and L_4 , together with capacitors

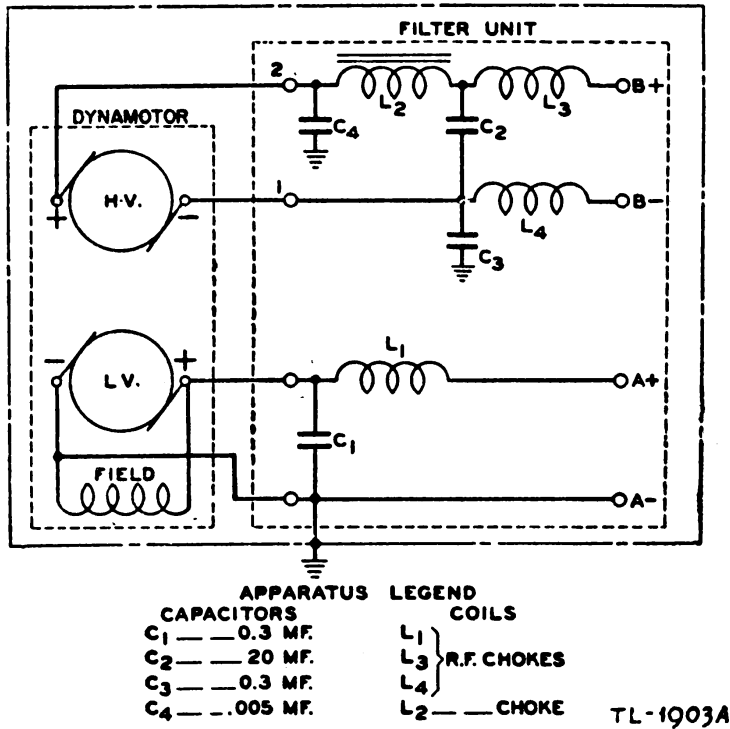


FIGURE 33.—Dynamotor unit DM-17-A, functional diagram.

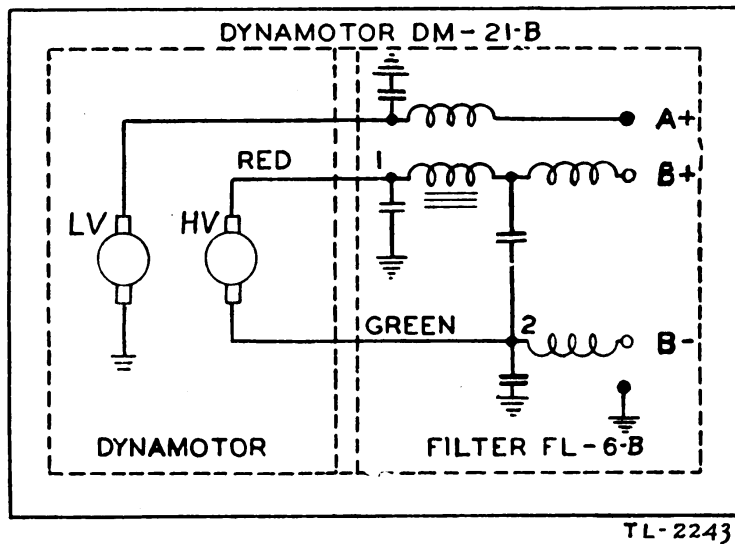


FIGURE 34.—Dynamotor unit DM-21-B, with filter unit FL-6-B, schematic diagram.

C_2 , C_3 , and C_4 , constitute a combination audio frequency and radio frequency filter circuit which reduces commutation ripple to a value

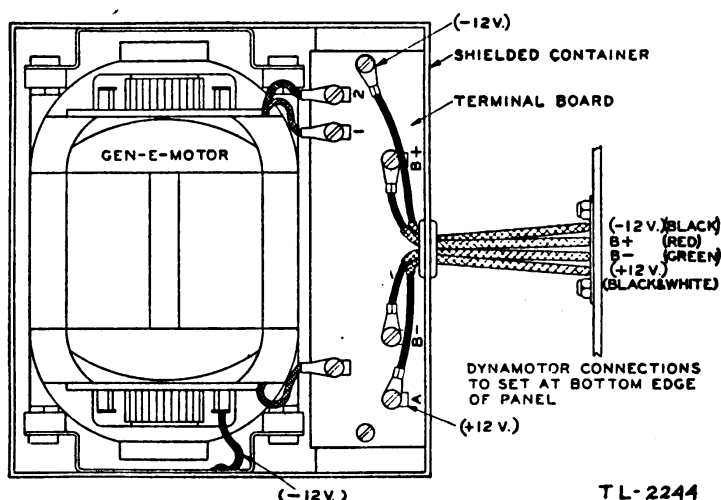


FIGURE 35.—Dynamotor unit DM-17-A, interior view.

which will not be objectionable and also prevents radio frequency interference from being transmitted by the dynamotor to the receiver circuits. Dynamotor DM-21-B is similar to and performs the same functions for the radio receiver BC-312-C (fig. 34). Under full load conditions, this dynamotor requires 3 amperes at 14 volts d. c., with an output of approximately 90 milliamperes at 235 volts d. c. A filter unit FL-6-B prevents radiation of radio frequency interference into the low-voltage supply circuit, and also acts as a combination audio frequency and radio frequency filter circuit which reduces commutator ripple to a value which will not be objectionable, and also prevents radio frequency interference being transmitted by the dynamotor to the receiver circuits. The filter unit FL-6-B is readily removable in the case of DM-21-B. Dynamotor DM-21-B cannot be used to replace DM-17-A. (Circuit references in this paragraph are not listed in paragraph 41.)

SECTION IV

SERVICING AND REPAIR

	Paragraph
Servicing.....	32
Inspections.....	33
Lubrication.....	34
Special adjustments to radio transmitters BC-191-A and BC-191-C.....	35
Normal current, resistance, and voltage readings.....	36
Procedure in case of set failure.....	37
Locating trouble.....	38
Repairs.....	39

32. Servicing.

Caution.—Care must be observed in servicing this radio equipment. Using personnel will make only such repairs as are indicated in paragraph 39. Servicing should be attempted only by competent personnel supplied with adequate test and repair equipment. An inexperienced operator, in attempting to locate and repair a minor trouble which a competent man could service in a few moments, may damage the equipment to such an extent as to require shipment to a depot for repair.

33. Inspections.—*a. Daily inspection.*—The various components of radio sets SCR-193-A, SCR-193-B, SCR-193-C, SCR-193-D, and SCR-193-E will be given a thorough visual inspection before and after each day's operation to insure that the set is ready for use at any time. This inspection includes examination of all cordage for proper fastening and for damage. All accessible components are examined for dirt and cleaned if necessary. At the end of a long period of storage, this inspection also includes a check to see that the dynamotor armatures revolve freely.

b. 50-hour inspection.—A thorough inspection of the complete installation will be made after every 50 hours of operation. This materially aids in securing uninterrupted performance in the field. The procedure for this inspection is as follows:

(1) Check to see that the storage battery is at the proper specific gravity and that the charging generator and regulator are adjusted so as to keep the battery fully charged.

(2) Clean the accumulated dust and dirt from all units, using an air hose or bellows, paying particular attention to the loading coil, item 1170, in the antenna compartment of the radio transmitter. Inspect the rotating coil, item 1167, in this compartment, and clean the winding thoroughly with carbon tetrachloride and a clean cloth. The rod (only) on which the wheel runs should be touched in several places with oil dag to insure smooth operation.

Caution.—Do not leave a surplus of oil dag such that the wheel and track surfaces will become contaminated by the lubricant.

(3) Make certain that all wiring is in place, that all mounting brackets and supports are rigidly fastened, and that all nuts and machine screws are supplied with lock washers and are tight.

(4) Determine that the cords are not damaged and that all ground connections are secure.

(5) Inspect plugs for proper fit and sockets for compressed pin springs. Pin springs which have taken a permanent set can usually be restored by a *very* light hammer blow at the end of the pin.

(6) Make certain that all cartridge fuses are held tightly in their clips. A loosely held fuse should be removed and the clips bent by hand until they grip the fuse tightly. Clean clips and fuse ends. Clean all contact surfaces.

(7) Inspect the high voltage fuses by removal from the mounting. Carefully clean all contact surfaces and replace the fuses.

(8) Inspect the antenna system for broken or frayed leads or loose mast sections. Wipe the insulator clean. To prevent loosening and loss of mast sections, joints should be covered with rubber tape. Make sure that antenna leads have not been bent close to metalwork where high antenna voltages might cause sparkovers.

(9) Inspect keys and microphones for defective cords and damaged plugs.

(10) Inspect dynamotor brushes for length. To inspect the receiving dynamotor DM-17-A and DM-21-B, it is necessary to remove the receiver chassis from its cabinet. Carefully place the chassis upside down and face the panel. Remove the cover of the dynamotor compartment DM-17-A by loosening the two knurled thumbscrews provided on the left-hand side and the two flathead screws on the right-hand side of the dynamotor. The brush holders on both the high and low voltage commutators will now be plainly visible, and either set of brushes may be removed without employing tools. Their removal is accomplished by stretching the helical springs and slowly but carefully disengaging the curved sections of the two brush holders from the posts in which they are engaged. *Be careful not to break the soldered pig-tail connections.* If it is desired to withdraw the brushes completely from the dynamotor, it will be necessary to unsolder the pig-tail connections on the brush holders. Inspect the face of each brush. It should show that at least 70 percent of the face of the brush is making contact with the commutator. The brush face should show no deep scratches or rough spots.

(11) Inspect both dynamotor commutators for cleanliness and for excessive wear.

(12) Rotate the dynamotor armature by hand, and make certain that it turns freely and is not rubbing against the field poles or leads. When the brushes have been removed, the armature should spin freely on its bearings.

(13) Upon completion of an inspection, all plugs and sockets should be completely reengaged and screwed down tightly. All tubes should be inserted all the way into their corresponding sockets and grid-cap connections, if any, firmly made. Chassis should be effectively locked in their boxes by means of the locking catches on the front panels.

c. *Receiver vacuum tubes.*—The vacuum tubes used in radio receiver

BC-312 and BC-312-C normally have an effective life of 2 to 3 years. However, to insure best performance of the receiver, they should be checked with an accurate tube checker. Tubes should be checked particularly just prior to extended field maneuvers and those which do not come up to maximum standards should be replaced. If no tube checker is available, all tubes should be replaced annually, the receiver carefully checked for performance, and circuits realigned if necessary.

34. Lubrication.—Lubrication should be accomplished in accordance with the chart below. *Do not use excessive amounts of oil or grease and do not allow electrical connections to become greasy.* Excess lubricant in dynamotors will tend to work out of bearing housings and onto commutators, where it will cause trouble; it also may cause the bearings to overheat. Make sure that lubricants and oilholes are clean and free from sand, grit, or dirt. These abrasives are the chief cause of bearing wear and the necessity for bearing replacement.

Lubrication chart

Apparatus	Points of lubrication	Lubricant to be employed	Quantity of lubricant	Service periods	Special instructions
Dynamotors DM-17-A and DM-21-B.	Oil cups-----	SAE 10 mineral oil----	One drop each bearing.	500 hours-----	These bearings are of the sealed, ball bearing type, packed with grease at the time of manufacture. Any oil above the stated amount will do more harm than good.
	Ball bearings---	High temperature ball bearing grease 295 grade Air Corps specification No. 36-50; "Refined Calol Grease" made by New Departure Mfg. Co.; Grease made by N. Y. & N. J. Lubricant Co.	As required by special instructions.	Whenever armature is removed and replaced.	For removal of the armature of dynamotor DM-17-A, the dynamotor case must first be separated from the chassis. Turn the receiver chassis upside down and remove four screws holding the cover in place. After lifting this cover disconnect all leads to the receiver. Next, completely remove dynamotor DM-17-A. (Six screws in the front panel and two in the subpanel hold mounting brackets.) DM-21-B is removed by unsoldering all connections at the connection strip. Remove the two screws adjacent to the 1st i. f. and 2d i. f. tube sockets and

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the six screws holding the brackets to the front panel. It is then necessary to separate physically the dynamotor proper from its case. This is accomplished by removal of the soldered ground lead, the leads marked 1 and 2, and the unmarked lead, and lifting the unit from its cradle. This operation involves the forcing of the two U-brackets holding the four rubber mounting grommets. The end brackets are next removed and the armature withdrawn from position. The quantity of grease should be sufficient to cover thoroughly the ball bearing assembly surfaces. Excess grease should be removed.

Lubrication chart—Continued

Apparatus	Points of lubrication	Lubricant to be employed	Quantity of lubricant	Service periods	Special instructions
Dynamotor units BD-77-A and BD-77-B.	End bearing oilers.	SAE 40 mineral oil	3 to 5 drops	2,000 hours operation or at 6 month intervals.	Remove screw cap on the top of bearing housing.
	Ball bearings	High temperature ball bearing grease 295 grade Air Corps specification No. 36-50; "Refined Calol Grease" made by New Departure Mfg. Co; Grease made by N. Y. & N. J. Lubricant Co.	As required by special instructions.	5,000 hours operation or at yearly intervals.	Remove the screw cap on the top of the bearing housing and add approximately a ½ inch cube of grease. At least every 2 years remove the armature from the dynamotor, thoroughly clean the bearings and bearing housings with carbon tetrachloride, and repack each ball bearing with approved ball bearing grease. The quantity of grease should be sufficient to cover thoroughly the ball bearing assembly surfaces. Excess grease should be removed.
Radio receivers BC-312 and BC-312-C.	Gears and bearings of band change mechanism and condenser drive.	Petrolatum	Sufficient to permit quiet smooth drive of mechanism involved.	When required	The various gears and bearings of the radio set chassis are lubricated at the time of manufacture with a sufficient amount of lubricant to last the life of the equipment, and unless operated in an abnormal manner

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should never require lubrication. In the event that such lubrication becomes necessary, petrolatum should be very sparingly used.

Radio transmitters BC-191-A and BC-191-C; Transmitter tuning units TU-5-A and TU-6-A; Control box BC-321 and Radio control box BC-309.	Switch shafts.	SAE 20 mineral oil----	Very thin film--	Whenever apparatus is removed from service and thoroughly cleaned.
	Switch contacts; switching relay.	White petroleum jelly--	Very thin film----	Whenever apparatus is to be removed from service and thoroughly cleaned.

35. Special adjustments to radio transmitters BC-191-A and BC-191-C.—*a. Auxiliary equipment.*—The following auxiliary apparatus should be used to adjust properly radio transmitter BC-191-A. This auxiliary apparatus is not issued as a component of these sets but must be obtained elsewhere.

- (1) One frequency meter set SCR-211-A.
- (2) One radio frequency ammeter (0-1 ampere full scale).
- (3) One 100-micromicrofarad condenser, either fixed or variable, capable of withstanding at least 2,500 or 5,000 volts d. c.
- (4) One noninductive resistor of approximately 10 ohms, capable of carrying one ampere.

NOTE.—The condenser, resistor, and r. f. ammeter are connected in series, and the combination connected between the antenna and ground binding posts of the transmitter to form a dummy antenna load for the transmitter.

b. Neutralization.—Radio transmitters BC-191-A and BC-191-C are adjusted for neutralization by the manufacturer and normally will never require adjustment in the field. When necessary, neutralization may be checked and adjusted as follows:

- (1) Turn the transmitter OFF ON switch to the OFF position.
- (2) Remove the tube compartment shield.
- (3) Remove the power amplifier tube (VT-4-C) from its socket and cover *one* and only *one* filament pin with a piece of paper and replace the tube. (When the transmitter is turned on, the power amplifier filament should not light.)
- (4) Connect the dummy antenna (see note in *a* above) in series with the radio frequency ammeter to the transmitter.
- (5) Place the TONE CW VOICE switch on CW.
- (6) Set the MO TUNING and PA TUNING controls for the center of the frequency band in accordance with data on the calibration chart. (2,250 kc. when tuning unit TU-5-A is employed, or 3,750 kc. when tuning unit TU-6-A is employed.)
- (7) Turn the transmitter OFF ON switch to the ON position.
- (8) Tune the antenna circuit to resonance as prescribed in paragraph 25b(1)(l) to (o), inclusive, using the 0-1, r. f. ammeter in the dummy antenna to provide the indication of resonance.
- (9) Adjust the control marked PA TUNING until the 0-1, r. f. ammeter in the dummy antenna circuit indicates a maximum current in the dummy antenna.
- (10) Remove the calibration chart by turning the four knurled screws at the corners.
- (11) Unlock the neutralizing capacitory lock by turning, with a screw driver, the lock to the left one quarter turn.

(12) Rotate the neutralizing capacitory control until the current, as read by the radio frequency ammeter in the dummy antenna, is reduced to zero.

(13) Slightly readjust the antenna and power amplifier circuits to be sure that they are on resonance. If the ammeter in the dummy antenna shows an increased reading, repeat the operations (8) through (12).

(14) Lock the final position of the neutralizing capacitor adjustment, replace the calibration chart, and restore the transmitter for normal operation. The tuning units will each be neutralized when the neutralizing capacitor is approximately one-half engaged.

c. Speech amplifier grid bias adjustment.—The grid bias on the speech amplifier in radio transmitter BC-191-A is adjusted by the manufacturer and seldom requires readjustment in the field. The adjustment is not critical. Should the initial setting become displaced, remove the tube compartment, and set the S. A. BIAS control between 5 and 6.

d. Calibration reset.—The calibration of the transmitters should be checked periodically, employing the frequency meter SCR-211-A for the purpose. It is most important that the calibration be checked whenever the master oscillator tube is changed. If the check indicates that the transmitter varies more than 25 kilocycles from the frequency indicated on the calibration chart, the oscillator frequency should be adjusted as follows:

(1) Warm up the transmitter for at least 30 minutes, with the antenna tuned for rated output, prior to adjusting.

(2) Set the frequency meter SCR-211-A to 3000 kc. when transmitter tuning unit TU-5-A is used, or 4500 kc. when transmitter tuning unit TU-6-A is used.

(3) Adjust the transmitter for operation on c. w. at a frequency of 3000 kc. or 4500 kc., as the case may be, as prescribed in paragraph 25b(1). Use data from the calibration chart for the setting on the control MO TUNING, and approach this setting from the lower dial readings.

(4) Open the calibration reset port located to the right of the TEST KEY (fig. 2), and with a screw driver, adjust the calibration reset capacitor 1104 until the transmitter zero beats with the frequency meter.

(5) Close the calibration reset port.

36. Normal current, resistance, and voltage readings.—The following normal current, resistance, and voltage readings are furnished for the information and guidance of servicing personnel. (The values

are approximate and will vary slightly with different sets and different measuring equipments.

a. Current readings.—(1) The current consumptions of the receiver and transmitter measured at the vehicular storage battery are listed in (a) below. The voltages listed are measured at the battery. Where the voltage supplied is 14.2 volts, the vehicular storage battery generator is operating (vehicular motor running).

(a) *Radio receivers BC-312 and BC-312-C.*

Receiver	Voltage (volts)	(Current amperes)	
		Heaters off	Heaters on
BC-312.....	{ 12.....	4.2	7.4
	{ 14.2.....	4.6	8.1
BC-312-C.....	{ 12.....	4.2	} No heaters
	{ 14.2.....	4.6	

(b) *Radio transmitters BC-191-A and BC-191-C.*

Battery voltage (volts)	Current (amperes)			
	Total		Filaments	
	C. w.	Tone and voice	C. w.	Tone and voice
14.2.....	39.4	56.9	8.1	14.9

(2) The following table gives the current and voltage readings at the terminals of the dynamotors BD-77-A and BD-77-B for three values of load current.

Caution.—Do not operate this equipment with the high voltage leads exposed.

Input		Output	
Volts	Amperes	Volts	Milliamperes
14.....	14 -15	1, 140-1, 160	0
14.....	30 -32.5	1, 070-1, 090	220
14.....	40.5-43.5	1, 025-1, 050	350

NOTE.—The input current above includes that taken by the starting relay.

b. The normal voltage readings for radio receivers BC-312 and BC-312-C.—The tables of voltages shown below are provided for the information and guidance of servicing personnel. The readings are made at the tube prongs using the set analyzer of test set I-56-A, with an input voltage of 14 volts, the OFF MVC AVC switch in the MVC position, and the VOL control turned to maximum. For the c. w. oscillator readings, the CW OSC OFF ON switch is in the ON position. For all other readings this switch is in the OFF position. Adapter FT-211 must be used when the set analyzer of test set I-56-A is employed for measurement on the two r. f. and first detector tubes. The plug of the adapter is inserted into the tube socket and its grid stud connected to the receiver grid clip. The socket end of the adapter is connected to the set analyzer plug, and the grid clip on the adapter is connected to the stud on the set analyzer plug. Measurements are then made in the regular manner.

Tube	Voltages (volts)			
	Fila- ment	Cathode to ground	Screen grid to ground	Plate to ground
1st r. f. amplifier (VT-86) -----	6. 5	3. 5	92	207
2d r. f. amplifier (VT-86) -----	6. 5	3. 3	82	217
1st detector (VT-87) -----	6. 5	2. 5	77	217
1st i. f. amplifier (VT-86) -----	6. 5	3. 6	94	215
2d i. f. amplifier (VT-86) -----	6. 5	3. 7	97	217
C. w. oscillator (VT-65) -----	6. 5	-----	-----	100
Diode; 1st audio (VT-88) -----	6. 5	6. 7	-----	215
2d audio amplifier (VT-66) -----	6. 5	18. 5	222	212
R. f. oscillator (VT-65) {	Band A -----	6. 5	20	106
	Band B -----	-----	15	102
	Band C -----	-----	12	104
	Band D -----	-----	0	98
	Band E -----	-----	0	95
	Band F -----	-----	0	97

c. Normal resistance values for radio transmitters BC-191-A and BC-191-C.—(1) *General.*—Normal resistance values obtained by point to ground measurements on the radio transmitters BC-191-A and BC-191-C, in a satisfactory condition, are indicated below. Use of these data in connection with similar measurements on faulty equipment, combined with a logical circuit analysis, will frequently disclose the source of trouble in inoperative or improperly operating

transmitters. The readings were taken under the following conditions, and similar conditions must be reproduced exactly if comparison measurements on a faulty transmitter are to be effected.

- (a) All tubes and cords are removed from the transmitter.
- (b) The pilot light LM-27 is removed.
- (c) The CW TONE VOICE switch is set on VOICE.
- (d) Tuning unit TU-5-A or TU-6-A is inserted.
- (e) The OFF ON switch is in the ON position.
- (f) A fuse FU-12 is in the active mounting.

(2) *Measurements from tube sockets.*—Tube socket connections, from which the measurements shown below are made, are numbered as shown in figure 36.

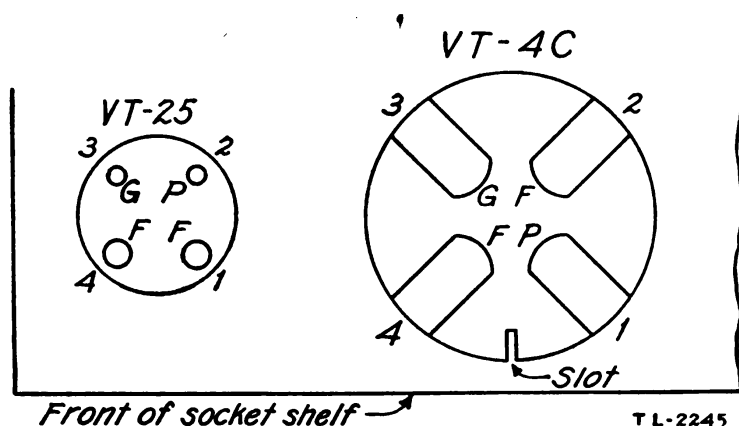


FIGURE 36.—Transmitting vacuum tube socket pin locations.

Stage	Tube	Tube socket pin			
		1	2	3	4
Speech amplifier..	VT-25	80 ohms..	1 megohm	.2-.203 megohm..	1 ohm.
Master oscillator..	VT-4C	1 megohm..	80 ohms..	.2075 megohm..	0 ohm.
Power amplifier..	VT-4C	1 megohm..	80 ohms..	.21 megohm....	0 ohm.
Modulator.....	VT-4C	1 megohm..	80 ohms..	.203-.206 megohm.	0 ohm.

(3) *Measurements from cord sockets.*—The socket pins from which measurements of resistance to ground are made are identified by number as shown in figure 37. This figure represents the cord connecting sockets for radio transmitters BC-191-A and BC-191-C as viewed from the outside of the set. Sockets are easily identified by the number and arrangement of the pins therein. Resistance measurements from these socket pins to ground are indicated below.

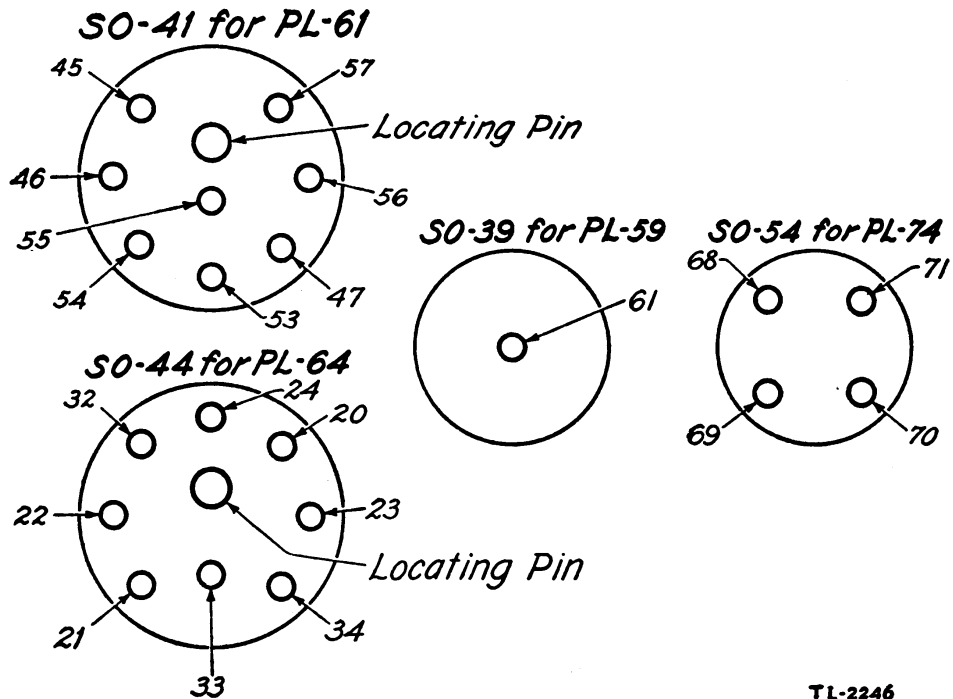


FIGURE 37.—Cording socket pin nomenclature.

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SO-44 for PL-64		SO-41 for PL-61		SO-54 for PL-74		SO-39 for PL-59	
Pin No.	Resistance to ground	Pin No.	Resistance to ground	Pin No.	Resistance to ground	Pin No.	Resistance to ground
34	100 ohms.....	45	85 ohms.....	68	0 ohm....	61	1 megohm.
¹ 23	60-240 ohms..	46	85 ohms.....	69	0 ohm....		
23	Open.....	54	85 ohms.....	70	120 ohms..		
24	0 ohm.....	47	0 ohm.....	71	95 ohms..		
32	0 ohm.....	53	0 ohm.....				
22	Open.....	56	0 ohm.....				
21	Open.....	57	0 ohm.....				
² 33	32 ohms..... 61 ohms..... 91 ohms..... 122 ohms.....	55	.210 megohm....				

¹ INPUT LEVEL set at 0 gives 240 ohms, and set at 10 gives 60 ohms with intermediate values of resistance for other settings of the control.

² Side tone adjustment (stepwise) values, keying relay manually operated.

0—Zero resistance.

37. Procedure in case of set failure.—*a. Do not change fuses or make repairs with the high voltage on.* Failure of this radio equipment to operate properly is usually due to worn, broken, or disconnected cords, plugs or sockets, run-down storage battery, worn dynamotor

brushes, defective fuses, or defective tubes. When set failure is encountered, these items should be checked before initiating a detailed check of component parts. If failure of both transmitter and receiver occurs simultaneously, the trouble is usually in the primary power source of leads connected thereto. If only one component fails to operate, determine, if feasible, if it is receiving proper supply voltages. This usually determines whether the trouble is inside or outside of the component. Check fuses in the equipment at an early stage in "trouble shooting." Do not continue to burn out fuses before looking elsewhere to determine the basic source of trouble.

b. When exposed to conditions of excessive humidity, failure to operate properly may occur as the result of moisture accumulations across insulators or insulating structures. Every precaution should be taken to keep these installations moisture free.

Caution.—Many of the unit parts comprising these transmitters and receivers are readily damaged by excessive or abrupt applications of heat. A free flow of warm air through a chassis will accomplish the desired drying in less time than the application of very warm air without a free flow through and subsequently out of a chassis.

38. Locating trouble.—The following causes of set trouble may be present in the event that the component fails to function properly:

a. Radio receivers BC-312 and BC-312-C.

Symptom	Cause
(1) No filament voltage----	Poor battery. Open power lead. Short circuited power lead. Poor plug contact. Burned-out fuse. Burned-out tube filament. Damaged bypass capacitor. Loose connection inside of the receiver.

The first five of the above causes should be checked before removing the receiver chassis from its cabinet.

Symptom	Cause
(2) No plate voltage-----	Poor battery. Open or shorted cord. Poor plug contact. Burned-out fuse. Defective dynamotor. Defective filter. ¹ Loose connection inside of the receiver. Shorted bypass capacitor. Open resistor.

¹ To check, remove the brush lead from terminal 2 of dynamotor terminal strip (see fig. 35) and check the actual brush voltage. If normal (or high) voltage is read, connect the brush lead to the lead removed from the terminal B. If receiver operates, the filter is damaged.

The first four of the above causes should be checked before removing the receiver chassis from its cabinet.

Symptom	Cause
(3) No audio frequency output.	Headset plug not completely inserted in jack. Defective headset, headset plug, or headset cord. Defective tube. ² Loose connections inside of the receiver. Damaged capacitor. Damaged resistor. Defective jack insulation. Breakdown on r. f. coils, leads, or switches. Defective band-change switch.

² Tubes used in these receivers should be checked with the tube checkers of test set I-56-A at least once a year. If found serviceable, they should be replaced in the identical sockets of the same receiver from which they were removed.

The first two causes should be checked before removing the receiver chassis from its cabinet. The last two causes will be indicated by lack of signal audio output, although some *audio noise* output is present.

Symptom	Cause
(4) No change in intensity of noise level when SEND REC switch is on SEND position and the transmitter is being keyed.	Antenna relay inoperative.
(5) Erratic noise in receiver-----	Defective headset or headset cord. Defective dynamotor. Temperature controls chattering (BC-312 only). ³ Antenna relay chattering. Dust or dirt in the receiver. A loose connection in the receiver. Defective tube. Defective capacitor or resistor in receiver.

³ This cause of trouble may be located or eliminated by operation of the HEATERS OFF ON switch and is found only in the BC-312.

The first possible cause of trouble should be checked before removing the receiver chassis from its cabinet.

Symptom	Cause
(6) A. c. ripple in output-----	Defective filter choke. Defective filter capacitor. Defective dynamotor.
(7) Ignition noise-----	Defective chassis grounding. Defective noise antenna. Defective vehicle bonding.
(8) Frequency calibration off-----	Improper alinement. ⁴

⁴ See paragraph 39.

Symptom	Cause
(9) Lack of sensitivity-----	Improper alinement. ⁴ Worn out tubes.

⁴ See paragraph 39.

b. Radio transmitters BC-191-A and BC-191-C.

Symptom	Cause
(1) No filament voltage-----	Poor battery. Open power lead. Short-circuited power lead. Defective TONE CW VOICE switch. Poor plug contact. Burned-out fuse. Damaged bypass capacitor. Dynamotor starting relay not functioning properly. Loose connection inside of the transmitter.
(2) No plate current-----	Open interlock. Poor battery. Open or shorted cord. Poor plug contact. Burned-out fuse. Defective dynamotor. Loose connection inside of the transmitter. Shorted bypass capacitor. Open resistor.
(3) No r. f. output-----	Damaged choke coil. Damaged master oscillator or power amplifier tubes. Damaged choke coil. Damaged coupling capacitor. No plate voltage. Excessive bias voltage, open grid. Output terminal strip not properly connected. Damaged antenna ammeter. Inoperative antenna switching relay and contacts. Defective TONE CW VOICE switch.

Symptom	Cause
(4) No voice modulation	Damaged speech amplifier or modulator tubes. Improper modulator bias. Defective speech amplifier bias. Microphone plug not properly in jack. Bad plug contacts. Defective microphone. Defective microphone cord. Defective microphone filter circuit. Damaged transformers. Open resistor.
(5) No tone modulation	Damaged speech amplifier or modulator tubes. Improper modulator bias. Defective speech amplifier bias. Defective TONE CW VOICE switch. Damaged resonating capacitors. Defective transformers. Open resistor.
(6) No side tone	Damaged transformer. Open resistor. Damaged speech amplifier tube. Damaged microphone or microphone circuits. Bad plug connections. Damaged resonating capacitors.

NOTE.—The bias voltages for the modulator tubes and the speech amplifier tube are derived from the grid resistor system of the power amplifier tube, and anything which will affect the proper operation of the power amplifier tube grid bias will affect the biasing of the audio frequency stages.

39. Repairs.—Repairs other than the following will not be attempted by using personnel unless specifically authorized under the provision of Appendix C, Signal Corps General Catalog:

a. Cords.—Cords may become defective because of an open circuit in one or more conductors, a short circuit between two or more conductors, or between any conductor and ground. These defects most frequently occur at the point of attachment of the cord to its corresponding plug. These points should be examined and where possible necessary repairs made. In the event that the damage occurs any great distance from either end of the cord, it is normally impossible to make a serviceable permanent repair of the cord. A new cord should be obtained and installed. However, in an emergency, the defective portion of the cord may be cut out and jumpers used to restore the necessary circuits until a new cord can be obtained. Cords CD-261 and CD-262 are concentric transmission lines each consisting of flexible shielded conduit containing an inner conductor supported by a

series of spaced insulating beads. These cords may be damaged by crushing or bending sharply. If it is found necessary to attach a terminating fitting or a concentric transmission line, before cutting the shield or conductor to length, the shield should be forced to its shortest length, and the conductor should be pulled tightly to straighten out any kinks. Temporary repair may sometimes be made by careful shaping to hold the inner conductor away from the outer shield. If these cords have been badly damaged, and the conductor cannot be straightened, they should be replaced as soon as practicable.

b. Headsets.—The failure of a headset to operate properly is usually due to a defective cord or plug which may be repairable. However, if the damage is within the phones, a new headset should be secured and the defective unit shipped to the proper agency for repair.

c. Dynamotors DM-17-A and DM-21-A.—Normally, if these dynamotors have become defective, they should be removed and replaced. Replacements are obtained through the usual channels. The replacement of brushes, turning down of commutators, freeing of bearings, and all repairing of defective receiver dynamotors is done at Signal Corps repair shops or Signal Corps radio sections at air depots. In event the dynamotor cannot be replaced, or where an emergency requires it, local repairs are allowable. Where local repairs are made, careful sanding-in of new brushes to fit the commutator, proper spring adjustment, and a running-in period are necessary to insure quiet receiver operation. If results following local replacement of brushes are unsatisfactory, the dynamotor should be returned to a depot for overhaul when it can best be spared. Commutators not unduly worn may be cleaned by using a fine grade of sandpaper and/or wiping off thoroughly with carbon tetrachloride. If the bearings are not damaged, but merely need freeing, a drop of light oil is added to each. If the trouble is due to an open or short-circuited winding, grooved commutators, or some other serious defect, the dynamotor should be replaced.

d. Dynamotor units BD-77-A and BD-77-B.—The probable causes of trouble in these units are loose or defective brushes, locked or damaged bearings, dirty or undercut commutator, open or short-circuited windings. These should all be checked and treated in the same manner as described in *c* above.

SECTION V

LISTS OF PARTS

	Paragraph
Components, weights, and dimensions.....	40
Replaceable parts.....	41

40. Components, weights, and dimensions.—Dimensions and weights, where unappreciable, are omitted

SCR-193-A	SCR-193-B	SCR-193-C	SCR-193-D	SCR-193-E	Article	Dimensions (inches)					Unit weight (pounds)
						Height	Width	Depth	Length	Diameter	
2	2	2			Adapter FT-177-A ⁶	½	2	2			0.09
1	1	1	1	1	Box BX-8	9¾	8¼	7½			6.25
1	1	1	1	1	Box BX-19	1¾	12¼	4¼			2.5
1		1	1		Box BX-21	13½	10	11¼			2.5
4	4	4	4	4	Brush BR-5; spare (includes spring)						.01
4	4	4	4	4	Brush BR-6; spare (includes spring)						.08
2	2	2			Brush, H. V., for DM-17-A (spare)						
			2	2	Brush, H. V., for DM-21-B (spare)						
2	2	2			Brush, L. V., for DM-17-A (spare)						
			2	2	Brush, L. V., for DM-21-B (spare)						
				1	Cabinet CH-60	29 ¹³ / ₁₆	53%	11½			
1	1	1	1	1	Case CS-48 (for transmitter tuning unit)	8	16¾	8	2	¾	4.37
1		1			Conduit CT-4					1	
		1			Connector, bulkhead						
1	1	1			Control box BC-321, including cord CO-173	3	5	4			1.0
1		1			Cord CD-205				30		.84
	1				Cord CD-206				36		.87
1		1			Cord CD-221				30		
				1	Cord CD-226				48		.84
1		1			Cord CD-261				108		2.7
	1				Cord CD-262				146		3.5
1		1			Cord CD-269				30		.81
	1				Cord CD-277				96		1.5
1		1			Cord CD-288				30		.5

---	1	1	---	Cord CD-290	---	---	---	36	---	---	.56
---	1	1	---	Cord CD-292	---	---	---	36	---	---	.90
---	1	1	---	Cord CD-295	---	---	---	96	---	---	1.4
---	1	1	---	Cord CD-297	---	---	---	105	---	---	1.1
1	1	1	---	Cord CD-314	---	---	---	30	---	---	.7
2	2	2	---	Cord CD-318 (for microphone T-30-A)	---	---	---	84	---	---	---
---	---	1	1	Cord CD-320	---	---	---	9	---	---	---
---	---	1	1	Cord CD-346	---	---	---	8	---	---	---
---	1	1	---	Cord CD-358 ^s	---	---	---	36	---	---	.70
1	1	1	1	Cord CD-359 ⁴	---	---	---	30	---	---	.62
---	---	1	1	Cord CD-410	---	---	---	60	---	---	---
---	---	1	1	Cord CD-411	---	---	---	66	---	---	---
---	---	1	1	Cord CD-440	---	---	---	48	---	---	---
1	1	1	---	Cord CO-165-A	---	---	---	18	---	---	.37
---	---	1	1	Cord CO-170-A	---	---	---	60	---	---	---
---	1	1	---	Cord CO-175-A	---	---	---	63	---	---	.72
---	---	1	1	Cord CO-189	---	---	---	66	---	---	---
1	1	1	1	Cover BG-67 (for mast base MP-37)	---	---	---	12	3	---	.5
1	1	1	1	Cover BG-75	---	---	8	19	10	---	1.25
1	1	1	1	Cover BG-78	---	---	22	24	10	---	1.12
1	1	1	1	Cover BG-79	---	---	11	12	8	---	.5
1	1	1	1	Cover BG-84	---	---	25%	43%	10%	---	---
---	---	---	---	Dynamotor BD-77-A, including—	---	---	---	---	---	---	---
---	---	---	---	2 Brush BR-5.	---	---	---	---	---	---	---
---	---	---	---	2 Brush BR-6.	---	---	---	---	---	---	---
---	---	---	---	1 Fuse FU-13.	---	---	---	---	---	---	---
---	---	---	---	2 Fuse FU-18 (1 in use).	---	---	---	---	---	---	---
---	---	---	---	1 Fuse FU-22.	---	---	---	---	---	---	---
---	---	---	---	6 Fuse link M-141 (spares).	---	---	---	---	---	---	---
---	---	---	---	6 Fuse link M-168 (spares).	---	---	---	---	---	---	---
---	---	---	---	1 Mounting FT-107.	---	---	---	---	---	---	---
---	---	---	---	1 Wrench, setscrew.	---	---	---	---	---	---	---
1	1	1	1		---	---	11	11	7½	---	37.3

See footnotes at end of table.

40. Components, weights, and dimensions—Continued.

SCR- 193-A	SCR- 193-B	SCR- 193-C	SCR- 193-D	SCR- 193-E	Article	Dimensions (inches)					Unit weight (pounds)
						Height	Width	Depth	Length	Diam- eter	
					{ Dynamotor unit BD-77-B, including— 2 Brush BR-5. 2 Brush BR-6. 1 Fuse FU-13. 2 Fuse FU-22. 6 Fuse link M-141 (spares). 6 Fuse link M-168 (spares). 1 Mounting FT-107. 1 Wrench, setscrew. }	11	11	7½			37.3
					Fuse FU-13				2	½	.05
					Fuse FU-18				3	½	.01
					Fuse FU-18-A ^s				3	½	.01
					Fuse FU-21				1¼	¼	.01
					Fuse FU-21-A ^s				1¼	¼	.01
					Fuse FU-22				3	13/16	.13
					Head set P-19	2	6	6			1.12
					Instruction Book for Radio Sets BC-193-A, BC-193-B, and BC-193-C.						
					Instruction Book for Radio Transmitter BC-191-A.						
					Instruction Book for Radio Set BC-193-D.						
					Instruction Book for Radio Set BC-193-E.	2					
					Instruction Book for Radio Transmitter BC-191-C.	2					

[illegible]

See footnotes at end of table.

40. Components, weights, and dimensions.—Continued.

SCR- 193-A	SCR- 193-B	SCR- 193-C	SCR- 193-D	SCR- 193-E	Article	Dimensions (inches)				Unit weight (pounds)
						Height	Width	Depth	Length	
1	1	1			{ Radio receiver BC-312, including— 1 Dynamotor DM-17-A. 3 Fuse FU-21 (2 in use, 1 spare). 2 Lamp LM-27. 1 Mounting FT-162. Radio receiver BC-312-C, including— 1 Dynamotor DM-21-B. 3 Fuse FU-21-A (2 in use, 1 spare). 2 Lamp LM-27. 1 Mounting FT-162. Radio transmitter BC-191-A (less mount- ing FT-151-A), including— 3 Fuse FU-12. 1 Lamp LM-27. 1 Socket cap M-163-A. 1 Socket cap M-164-A. 2 Socket cap M-165-A. 2 Wrench, setscrew.	9¼	18	7		40
			1	1		10¾	18	19		40
1	1	1				20½	23½	9⅞		55.75

40. Components, weights, and dimensions—Continued.

SCR-193-A	SCR-193-B	SCR-193-C	SCR-193-D	SCR-193-E	Article	Dimensions (inches)				Unit weight (pounds)
						Height	Width	Depth	Length	
Feet	Feet	Feet	Feet	Feet						
10	10	10			Wire W-133					
10	10	10			Wire W-134					
10	10	10			Wire W-135					
10	10	10			Wire W-136					
10	10	10			Wire W-137					
10	10	10			Wire W-138					
10	10	10			Wire W-139					
10	10	10			Wire W-140					

¹ In SCR-193-A and SCR-193-C, adapter FT-177 may be substituted for adapter FT-177-A.

² Mast base MP-14 or MP-38 may be substituted for mast base MP-37 and shield MP-38. The shield MP-14 or MP-38 is used on the SCR-193-C only.

³ Sets of this type issued prior to September 1, 1939, required one junction box (no type number) furnished by the Ordnance Department, one terminal block TM-183 and jack JK-34-A (or JK-34) furnished by the Signal Corps in lieu of one junction box TM-188 which is an assembly of these units.

⁴ In SCR-193-A and SCR-193-C, cord CD-289 may be substituted for cord CD-359 in sets of this type issued prior to September 1, 1939.

⁵ In SCR-193-B, cord CD-291 may be substituted for cord CD-358 in sets issued prior to September 1, 1939.

⁶ In SCR-193-B, adapter FT-177 may *not* be substituted for adapter FT-177-A.

⁷ Microphone T-17 may be substituted for microphone T-30-A, in which case cord CD-318 is not used.

⁸ Fuses FU-18 and FU-21 may be substituted for FU-18-A, and FU-21-A respectively. The "A" series have a longer time delay.

41. Replaceable parts.—a. Radio receiver BC-312.

Reference No.	Stock No.	Name of part	Description	Function	Drawing No.
C ₁ -----	3D289----	Capacitor CA-289----	Variable air; 3-25 μ f.-----	Band A trimmer 1st r. f.-----	SC-A-1728
C ₂ -----	3D291----	Capacitor CA-291----	Variable air; 6-100 μ f.-----	Band B trimmer 1st r. f.-----	SC-A-1728
C ₃ -----	3D291----	Capacitor CA-291----	Variable air; 6-100 μ f.-----	Band C trimmer 1st r. f.-----	SC-A-1728
C ₄ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band D trimmer 1st r. f.-----	SC-A-1728
C ₅ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band E trimmer 1st r. f.-----	SC-A-1728
C ₆ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band F trimmer 1st r. f.-----	SC-A-1728
C ₇ -----	3D289----	Capacitor CA-289----	Variable air; 3-25 μ f.-----	Band A trimmer 2d r. f.-----	SC-A-1728
C ₈ -----	3D291----	Capacitor CA-291----	Variable air; 6-100 μ f.-----	Band B trimmer 2d r. f.-----	SC-A-1728
C ₉ -----	3D291----	Capacitor CA-291----	Variable air; 6-100 μ f.-----	Band C trimmer 2d r. f.-----	SC-A-1728
C ₁₀ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band D trimmer 2d r. f.-----	SC-A-1728
C ₁₁ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band E trimmer 2d r. f.-----	SC-A-1728
C ₁₂ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band F trimmer 2d r. f.-----	SC-A-1728
C ₁₃ -----	3D289----	Capacitor CA-289----	Variable air; 3-25 μ f.-----	Band A trimmer 1st det.-----	SC-A-1728
C ₁₄ -----	3D291----	Capacitor CA-291----	Variable air; 6-100 μ f.-----	Band B trimmer 1st det.-----	SC-A-1728
C ₁₅ -----	3D291----	Capacitor CA-291----	Variable air; 6-100 μ f.-----	Band C trimmer 1st det.-----	SC-A-1728
C ₁₆ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band D trimmer 1st det.-----	SC-A-1728
C ₁₇ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band E trimmer 1st det.-----	SC-A-1728
C ₁₈ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band F trimmer 1st det.-----	SC-A-1728
C ₁₉ -----	3D289----	Capacitor CA-289----	Variable air; 3-25 μ f.-----	Band A trimmer r. f. osc.-----	SC-A-1728
C ₂₀ -----	3D291----	Capacitor CA-291----	Variable air; 6-100 μ f.-----	Band B trimmer r. f. osc.-----	SC-A-1728
C ₂₁ -----	3D291----	Capacitor CA-291----	Variable air; 6-100 μ f.-----	Band C trimmer r. f. osc.-----	SC-A-1728
C ₂₂ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band D trimmer r. f. osc.-----	SC-A-1728
C ₂₃ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band E trimmer r. f. osc.-----	SC-A-1728
C ₂₄ -----	3D290----	Capacitor CA-290----	Variable air; 4-50 μ f.-----	Band F trimmer r. f. osc.-----	SC-A-1728
C ₂₅ -----	3D294----	Capacitor CA-294----	Fixed air; 125 μ f.-----	Padder 1st r. f.-----	SC-D-2575
C ₂₆ -----	3D293----	Capacitor CA-293----	Variable air; 10-210 μ f.-----	Antenna alinement-----	SC-A-2580

a. Radio receiver BC-312—Continued.

Reference No.	Stock No.	Name of part	Description	Function	Drawing No.
C ₂₇ -----	3D284-----	Capacitor CA-284-----	Molded, paper; 0.05 μ f.-400 v-----	1st r. f. bypass-----	SC-D-1995
C ₂₈ -----	(1)-----	Capacitor-----	Ganged with C ₃₄ , C ₄₆ , C ₈₂ ; 13-226 μ f.	1st r. f. tuning-----	SC-D-2568
C ₂₉ -----	3D195-----	Capacitor CA-195-----	{ Metal encased as one unit 0.05 μ f.-300 v----- 0.05 μ f.-300 v----- 0.05 μ f.-300 v-----	1st r. f. cathode bypass-----	SC-D-512
C ₃₀ -----				1st r. f. screen bypass-----	SC-D-512
C ₃₁ -----				1st r. f. "B" supply bypass-----	SC-D-512
C ₃₂ -----	3D284-----	Capacitor CA-284-----	Molded paper; 0.05 μ f.-400 v-----	1st r. f. plate bypass-----	SC-D-1995
C ₃₃ -----	3D266-----	Capacitor CA-266-----	Mica; 100 μ f-----	2d r. f. grid coupling-----	SC-D-1993
C ₃₄ -----	(1)-----	Capacitor-----	Ganged with C ₂₈ , C ₄₆ , C ₈₂ ; 13- 226 μ f.	2d r. f. tuning-----	SC-D-2568
C ₃₅ -----	3D195-----	Capacitor CA-195-----	{ Metal encased as one unit 0.05 μ f.-300 v----- 0.05 μ f.-300 v----- 0.05 μ f.-300 v-----	2d r. f. cathode bypass-----	SC-D-512
C ₃₆ -----				2d r. f. screen bypass-----	SC-D-512
C ₃₇ -----				2d r. f. "B" supply bypass-----	SC-D-512
C ₃₈ -----	3D294-----	Capacitor CA-294-----	Fixed air; 125 μ f-----	Padder, 1st det-----	SC-D-2575
C ₃₉ -----	3D284-----	Capacitor CA-284-----	Molded, paper; 0.05 μ f.-400 v-----	2d r. f. plate bypass-----	SC-D-1995
C ₄₀ -----	3D294-----	Capacitor CA-294-----	Fixed air; 125 μ f-----	Padder, r. f. osc-----	SC-D-2575
C ₄₁ -----	3D278-----	Capacitor CA-278-----	Mica; 5 μ f-----	C. w. osc. coupling-----	SC-D-1993
C ₄₂ -----	3D300-----	Capacitor CA-300-----	Mica, aged; 3,000 μ f-----	Band C padder r. f. osc-----	SC-D-1993
C ₄₃ -----	3D297-----	Capacitor CA-297-----	Mica, aged; 1,600 μ f-----	Band B padder r. f. osc-----	SC-D-1993
C ₄₄ -----	3D299-----	Capacitor CA-299-----	Mica, aged; 750 μ f-----	Band A padder r. f. osc-----	SC-D-1993
C ₄₅ -----	3D266-----	Capacitor CA-266-----	Mica; 100 μ f-----	1st det. grid coupling-----	SC-D-1993
C ₄₆ -----	(1)-----	Capacitor-----	Ganged with C ₂₈ , C ₃₄ , C ₈₂ ; 13- 226 μ f.	1st det. tuning-----	SC-D-2568
C ₄₇ -----	3D266-----	Capacitor CA-266-----	Mica; 100 μ f-----	R. f. osc. coupling-----	SC-D-1993

C ₄₈ ----	Capacitor CA-195	Metal encased as one unit Variable air, with shaft; 4-50 μμf.	0.05 μf.-300 v.	1st det. cathode bypass	SC-D-512
C ₄₉ ----				1st det. screen bypass	SC-D-512
C ₅₀ ----				1st det. "B" supply bypass	SC-D-512
C ₅₁ ----				Crystal phasing	SC-A-1728
3D323	Capacitor CA-323				
C ₆₂ ----	Capacitor CA-266	Mica; 100 μμf.		1st i. f. grid coupling	SC-D-1993
C ₆₃ ----	Capacitor CA-296	Mica, aged; 400 μμf.		1st det., plate	SC-D-1993
C ₆₄ ----	Capacitor CA-281	Molded, paper; 0.01 μf.-400 v.		1st det., plate bypass	SC-D-1995
C ₆₅ ----	Capacitor CA-295	Mica; 50 μμf.		2d i. f. grid	SC-D-1993
C ₆₆ ----	Capacitor CA-281	Molded, paper; 0.01 μf.-400 v.		2d i. f. a. v. c. bypass	SC-D-1995
C ₆₇ ----	Capacitor CA-295	Mica; 50 μμf.		1st i. f. plate	SC-D-1993
C ₆₈ ----	Capacitor CA-281	Molded, paper; 0.01 μf.-400 v.		1st i. f. plate bypass	SC-D-1995
C ₆₉ ----	Capacitor CA-302	Modification of CA-195	0.05 μf.-300 v.	1st i. f. cathode bypass	SC-D-2567
C ₇₀ ----	Capacitor CA-284	Molded, paper; 0.05 μf.-400 v.		1st i. f. screen bypass	SC-D-2567
C ₇₁ ----	Capacitor CA-281	Molded, paper; 0.01 μf.-400 v.		1st i. f. "B" supply bypass	SC-D-2567
C ₇₂ ----	Capacitor CA-295	Mica; 50 μμf.		1st det. a. v. c. bypass	SC-D-1995
C ₇₃ ----	Capacitor CA-295	Mica; 50 μμf.		1st i. f. a. v. c. bypass	SC-D-1995
C ₇₄ ----	Capacitor CA-295	Mica; 50 μμf.		Diode input	SC-D-1993
C ₇₅ ----	Capacitor CA-281	Molded, paper; 0.01 μf.-400 v.		2d i. f. plate	SC-D-1993
C ₇₆ ----	Capacitor CA-281	Molded, paper; 0.01 μf.-400 v.		2d i. f. plate bypass	SC-D-1995
C ₇₇ ----	Capacitor CA-279	Mica; 10 μμf.		Diode a. v. c. coupling	SC-D-1993
C ₇₈ ----	Capacitor CA-301	Modification of CA-195	0.05 μf.-300 v.	2d i. f. cathode bypass	SC-D-2567
C ₇₉ ----	Capacitor CA-218	Mica; 150 μμf.		2d i. f. screen bypass	SC-D-2567
C ₈₀ ----	Capacitor CA-193	Mica; 500 μμf.		2d i. f. "B" supply bypass	SC-D-2567
C ₈₁ ----	Capacitor CA-301	Modification of CA-195	0.05 μf.-300 v.	Diode, r. f. filter	SC-D-1993
C ₈₂ ----	Capacitor CA-281	Molded, paper; 0.01 μf.-400 v.		Diode, r. f. filter	SC-D-1993
C ₈₃ ----	Capacitor CA-295	Mica; 50 μμf.		Diode, cathode bypass	SC-D-2567
C ₈₄ ----	Capacitor CA-281	Molded, paper; 0.01 μf.-400 v.		1st audio plate bypass	SC-D-2567
C ₈₅ ----	Capacitor CA-295	Mica; 50 μμf.		A. v. c. filter bypass	SC-D-2567
C ₈₆ ----	Capacitor CA-281	Molded, paper; 0.01 μf.-400 v.		2d audio coupling	SC-D-1995
C ₈₇ ----	Capacitor CA-295	Mica; 50 μμf.		2d i. f. grid	SC-D-1993

a. Radio receiver BC-312—Continued.

Reference No.	Stock No.	Name of part	Description	Function	Drawing No.
C ₇₈ -----	3D276-----	Capacitor CA-276-----	Metal en- cased as one unit { 0.1 μ f.-400 v----- 0.1 μ f.-400 v----- 0.1 μ f.-400 v-----	Heater bypass-----	SC-D-512
C ₇₉ -----				Heater bypass-----	SC-D-512
C ₈₀ -----				2d audio plate bypass-----	SC-D-512
C ₈₁ -----	3D281-----	Capacitor CA-281-----	Molded, paper; 0.01 μ f.-400 v-----	1st audio coupling-----	SC-D-1995
C ₈₂ -----	(1)-----	Capacitor-----	Ganged with C ₂₈ , C ₃₄ , C ₄₆ ; 13-226 μ f.	R. f. osc. tuning-----	SC-D-2568
C ₈₃ -----	3D277-----	Capacitor CA-277-----	Molded, paper; 0.1 μ f.-400 v-----	R. f. osc. plate bypass-----	SC-D-1995
C ₈₄ -----	3D280-----	Capacitor CA-280-----	Variable air, with shaft; 1-10 μ f.	C. w. osc. tuning-----	SC-A-1728
C ₈₅ -----	3D253-----	Capacitor CA-253-----	Variable air; 4-75 μ f-----	C. w. osc. trimmer-----	SC-A-1728
C ₈₆ -----	3D266-----	Capacitor CA-266-----	Mica; 100 μ f-----	C. w. osc. grid-----	SC-D-1993
C ₈₇ -----	3D284-----	Capacitor CA-284-----	Molded, paper; 0.05 μ f.-400 v-----	C. w. osc. plate bypass-----	SC-D-1995
C ₈₈ -----	3D266-----	Capacitor CA-266-----	Mica; 100 μ f-----	R. f. osc. grid-----	SC-D-1993
C ₈₉ -----	3D211-----	Capacitor CA-211-----	Mica; 0.002 μ f-----	Thermostat contacts-----	SC-D-1993
C ₉₀ -----	3D211-----	Capacitor CA-211-----	Mica; 0.002 μ f-----	Thermostat contacts-----	SC-D-1993
C ₉₁ -----	3D295-----	Capacitor CA-295-----	Mica; 50 μ f-----	1st i. f. plate-----	SC-D-1993
C ₉₂ -----	3D295-----	Capacitor CA-295-----	Mica; 50 μ f-----	Diode input-----	SC-D-1993
C ₉₃ -----	3D295-----	Capacitor CA-295-----	Mica; 50 μ f-----	2d i. f. plate-----	SC-D-1993
C ₉₄ -----	3D298-----	Capacitor CA-298-----	Mica; aged; 800 μ f-----	Crystal filter input-----	SC-D-1993
C ₉₅ -----	3D298-----	Capacitor CA-298-----	Mica; aged; 800 μ f-----	Crystal filter input-----	SC-D-1993
C ₉₆ -----	3D286-----	Capacitor CA-286-----	Mica; 75 μ f-----	C. w. osc. filter-----	SC-D-1993
C ₉₇ -----	3D286-----	Capacitor CA-286-----	Mica; 75 μ f-----	C. w. osc. filter-----	SC-D-1993
C ₉₈ -----	3D275-----	Capacitor CA-275-----	Paper; 4 μ f-----	2d audio cathode bypass-----	SC-D-512
C ₉₉ -----	3D284-----	Capacitor CA-284-----	Molded, paper; 0.05 μ f.-400 v-----	2d r. f. a. v. c. bypass-----	SC-D-1995
C ₁₀₀ -----	3D294-----	Capacitor CA-294-----	Fixed, air; 125 μ f-----	2d r. f. paddler-----	SC-D-2575
C ₁₀₁ -----	3D266-----	Capacitor CA-266-----	Mica; 100 μ f-----	1st r. f. grid coupling-----	SC-D-1993

C ₁₀₂ -----	3D284-----	Capacitor CA-284-----	Molded, paper; 0.05 μ f.-400 v.-	1st r. f. a. v. c. bypass-----	SC-D-1995
CX-----	2Z3501-6-----	Crystal DC-6-----	470 kc-----	Crystal filter unit-----	SC-A-1994
DM-----	3H1617A-----	Dynamotor DM-17-A-----		D. c. power pack-----	SC-D-2576
F ₁ -----	3Z1921-----	Fuse FU-21-----	10 a.-25 v-----	Dynamotor and filaments-----	
F ₂ -----	3Z1921-----	Fuse FU-21-----	10 a.-25 v-----	R. f. osc. compart. heaters-----	SC-D-439
J ₁ -----	2Z5534-----	Jack JK-34-----		1st audio phones-----	SC-D-439
J ₂ -----	2Z5534-----	Jack JK-34-----		2d audio phones-----	SC-D-483
J ₃ -----	2Z5533-----	Jack JK-33-----		Speaker-----	SC-D-483
J ₄ -----	2Z5533-----	Jack JK-33-----		Microphone-----	SC-D-439
J ₅ -----	2Z5534-----	Jack JK-34-----		Key-----	SC-D-2556
L ₁ -----	-----	Coil-----		Band A, 1st r. f-----	SC-D-2556
L ₂ -----	-----	Coil-----		Band B, 1st r. f-----	SC-D-2556
L ₃ -----	-----	Coil-----		Band C, 1st r. f-----	SC-D-2556
L ₄ -----	-----	Coil-----		Band D, 1st r. f-----	SC-D-2556
L ₅ -----	-----	Coil-----		Band E, 1st r. f-----	SC-D-2556
L ₆ -----	-----	Coil-----		Band F, 1st r. f-----	SC-D-2556
L ₇ -----	-----	Coil-----		Band A, 2d r. f-----	SC-D-2556
L ₈ -----	-----	Coil-----		Band B, 2d r. f-----	SC-D-2556
L ₉ -----	-----	Coil-----		Band C, 2d r. f-----	SC-D-2556
L ₁₀ -----	-----	Coil-----		Band D, 2d r. f-----	SC-D-2556
L ₁₁ -----	-----	Coil-----		Band E, 2d r. f-----	SC-D-2556
L ₁₂ -----	-----	Coil-----		Band F, 2d r. f-----	SC-D-2556
L ₁₃ -----	-----	Coil-----		Band A, 1st det-----	SC-D-2556
L ₁₄ -----	-----	Coil-----		Band B, 1st det-----	SC-D-2556
L ₁₅ -----	-----	Coil-----		Band C, 1st det-----	SC-D-2556
L ₁₆ -----	-----	Coil-----		Band D, 1st det-----	SC-D-2556
L ₁₇ -----	-----	Coil-----		Band E, 1st det-----	SC-D-2556
L ₁₈ -----	-----	Coil-----		Band F, 1st det-----	SC-D-2556
L ₁₉ -----	-----	Coil-----		Band A, r. f., osc-----	SC-D-2556
L ₂₀ -----	-----	Coil-----		Band B, r. f., osc-----	SC-D-2556
L ₂₁ -----	-----	Coil-----		Band C, r. f., osc-----	SC-D-2556
L ₂₂ -----	-----	Coil-----		Band D, r. f., osc-----	SC-D-2556

a. Radio receiver BC-312--Continued.

Reference No.	Stock No.	Name of part	Description	Function	Drawing No.
L ₂₃ ----	----	Coil	----	Band E, r. f., osc	SC-D-2556
L ₂₄ ----	----	Coil	----	Band F, r. f., osc	SC-D-2556
L ₂₅ ----	----	Coils	----	Ignition suppressor	SC-D-2571
L ₂₆ ----	----	Coils	----	Ignition suppressor	SC-D-2571
L ₂₇ ----	----	Coils	----	Ignition suppressor	SC-D-2571
L ₂₈ ----	{2Z9802/10 2Z9802/11	Coils of transformer C-202.	----	1st detector	SC-D-2564
L ₂₉ ----	{2Z9803/3 2Z9803/4	Coils of transformer C-203.	----	1st i. f.	SC-D-2564
L ₃₀ ----	{2Z9804/3 2Z9804/4	Coils of transformer C-204.	----	2d i. f.	SC-D-2564
L ₃₁ ----	----	Coil	----	C. w. beat oscillator	SC-D-2563
L ₃₂ ----	----	Coil	----	Filter, c. w. oscillator	SC-D-2563
LM ₁ ----	2Z5893	Neon lamp	----	Antenna overload protection	SC-A-1801
LM ₂ ----	2Z5927	Lamp LM-27	Pilot lamp	Dial light	SC-D-2573
LM ₃ ----	2Z5927	Lamp LM-27	Pilot lamp	Dial light	SC-D-2573
R ₁ ----	3Z4564	Resistor RS-164	Wire-wound, insul.; 500 ohms, 1 w.	Cathode bias, 1st r. f.	SC-D-970
R ₂ ----	3Z4569	Resistor RS-169	Carbon, insul.; 60,000 ohms, ½ w.	Screen grid, 1st r. f.	SC-D-970
R ₃ ----	3Z4549	Resistor RS-149	Carbon, insul.; 40,000 ohms, ½ w.	Screen grid, 1st r. f.	SC-D-970
R ₄ ----	3Z4572	Resistor RS-172	Carbon, 100,000 ohms, ½ w.	A. v. c. filter, 1st r. f.	SC-D-970
R ₅ ----	3Z4567	Resistor RS-167	Carbon, 1,000 ohms, ½ w.	Plate filter, 1st r. f.	SC-D-970
R ₆ ----	3Z4573	Resistor RS-173	Carbon, 2 megohms, ½ w.	Grid, 2d r. f.	SC-D-970
R ₇ ----	3Z4564	Resistor RS-164	Wire-wound, insul.; 500 ohms, 1 w.	Cathode bias, 2d r. f.	SC-D-970

R ₉	3Z4569	Resistor RS-169	Carbon, insul.; 60,000 ohms, ½ w.	Screen grid, 2d r. f.	SC-D-970
R ₉	3Z4549	Resistor RS-149	Carbon, insul.; 40,000 ohms, ½ w.	Screen grid, 2d r. f.	SC-D-970
R ₁₀	3Z4572	Resistor RS-172	Carbon, 100,000 ohms, ½ w.	A. v. c. filter, 2d r. f.	SC-D-970
R ₁₁	3Z4567	Resistor RS-167	Carbon, 1,000 ohms, ½ w.	Plate filter, 2d r. f.	SC-D-970
R ₁₂	3Z4573	Resistor RS-173	Carbon, 2 megohms, ½ w.	Grid, 1st det.	SC-D-970
R ₁₃	3Z4568	Resistor RS-168	Carbon, 50,000 ohms, ½ w.	Suppressor bias, 1st det.	SC-D-970
R ₁₄	3Z4566	Resistor RS-166	Wire-wound, insul.; 350 ohms, 1 w.	Cathode bias, 1st det.	SC-D-970
R ₁₅	3Z4540	Resistor RS-140	Carbon, insul.; 30,000 ohms, ½ w.	Screen grid, 1st det.	SC-D-970
R ₁₆	3Z4572	Resistor RS-172	Carbon, 100,000 ohms, ½ w.	A. v. c. filter, 1st det.	SC-D-970
R ₁₇	2Z4525	Resistor RS-125	Carbon, insul.; 1,000 ohms, ½ w.	Plate filter, 1st det.	SC-D-970
R ₁₈	3Z4572	Resistor RS-172	Carbon, 100,000 ohms, ½ w.	A. v. c. filter, 1st i. f.	SC-D-970
R ₁₉	3Z4564	Resistor RS-164	Wire-wound, insul.; 500 ohms, 1 w.	Cathode bias, 1st i. f.	SC-D-970
R ₂₀	3Z4563	Resistor RS-163	Carbon, insul.; 60,000 ohms, 1 w.	Screen grid, 1st i. f.	SC-D-970
R ₂₁	3Z4549	Resistor RS-149	Carbon, insul.; 40,000 ohms, ½ w.	Screen grid, 1st i. f.	SC-D-970
R ₂₂	3Z4525	Resistor RS-125	Carbon, insul.; 1,000 ohms, ½ w.	Plate filter, 1st i. f.	SC-D-970
R ₂₃	3Z4550	Resistor RS-150	Carbon, insul.; 100,000 ohms, ½ w.	A. v. c. filter, 2d i. f.	SC-D-970
R ₂₄	3Z4564	Resistor RS-164	Wire-wound, insul.; 500 ohms, 1 w.	Cathode bias, 2d i. f.	SC-D-970
R ₂₅	3Z4563	Resistor RS-163	Carbon, insul.; 60,000 ohms, 1 w.	Screen grid, 2d i. f.	SC-D-970
R ₂₆	3Z4549	Resistor RS-149	Carbon, insul.; 40,000 ohms, ½ w.	Screen grid, 2d i. f.	SC-D-970

a. Radio receiver BC-312—Continued

Reference No.	Stock No.	Name of part	Description	Function	Drawing No.
R ₂₇	3Z4525	Resistor RS-125	Carbon, insul.; 1,000 ohms, $\frac{1}{2}$ w.	Plate filter, 2d i. f.	SC-D-970
R ₂₈	3Z4571	Resistor RS-171	Wire-wound, insul.; 750 ohms, 1 w.	Cathode bias, diode	SC-D-970
R ₂₉	3Z4562	Resistor RS-162	Carbon, insul.; 250,000 ohms, $\frac{1}{2}$ w.	A. v. c. filter, diode	SC-D-970
R ₃₀	3Z4561	Resistor RS-161	Carbon, 1 megohm, $\frac{1}{3}$ w.	A. v. c. load	SC-D-970
R ₃₁	3Z4565	Resistor RS-165	Wire-wound, insul.; 1,000 ohms, 1 w.	Cathode bias, 2d audio	SC-D-970
R ₃₂	3Z4562	Resistor RS-162	Carbon, insul.; 250,000 ohms, $\frac{1}{2}$ w.	Grid, 1st a. f.	SC-D-970
R ₃₃	3Z4531	Resistor RS-131	Carbon, insul.; 50,000 ohms, $\frac{1}{2}$ w.	Grid, 2d a. f.	SC-D-970
R ₃₄	} 2Z7289	Potentiometer RS-174	{ 500,000 ohms } 50,000 ohms } 1 w.	Dual volume control	SC-D-1982
R ₃₅		Resistor RS-150		Minimum bias bleeder	SC-D-970
R ₃₆	3Z4550	Resistor RS-150	Carbon, insul.; 100,000 ohms, $\frac{1}{2}$ w.	C. w. osc. plate	SC-D-970
R ₃₇	3Z4550	Resistor RS-150	Carbon, insul.; 100,000 ohms, $\frac{1}{2}$ w.	Heater	
R ₃₈	3Z4578	Resistor RS-178	Metal encased; 15 w., 12 ohms, 14 v.	Heater	
R ₃₉	3Z4578	Resistor RS-178	Metal encased; 15 w., 12 ohms, 14 v.	Heater	
R ₄₀	3Z4578	Resistor RS-178	Metal encased; 15 w., 12 ohms, 14 v.	Heater	
R ₄₁	3Z4539	Resistor RS-139	Carbon, insul.; 30,000 ohms, 1 w.	Plate, r. f. osc.	SC-D-970

R ₄₂ -----	3Z4540-----	Resistor RS-140-----	Carbon, insul.; 30,000 ohms, ½ w.	Grid, r. f. osc.-----	SC-D-970
R ₄₃ -----	3Z4548-----	Resistor RS-148-----	Carbon, insul.; 200,000 ohms, ½ w.	Grid, c. w. osc.-----	SC-D-970
R ₄₄ -----	3Z4527-----	Resistor RS-127-----	Carbon, insul.; 3,000 ohms, ½ w.	Cathode, band C, r. f. osc.-----	SC-D-970
R ₄₅ -----	3Z4528-----	Resistor RS-128-----	Carbon, insul.; 5,000 ohms, ½ w.	Cathode, band B, r. f. osc.-----	SC-D-970
R ₄₆ -----	3Z4577-----	Resistor RS-177-----	Carbon, insul.; 7,500 ohms, ½ w.	Cathode, band A, r. f., osc.-----	SC-D-970
R ₄₇ -----	3Z4576-----	Resistor RS-176-----	Carbon, insul.; 60 ohms, ½ w.	Filament shunt, diode.-----	SC-D-970
R ₄₈ -----	3Z4569-----	Resistor RS-169-----	Carbon, insul.; 60,000 ohms, ½ w.	Screen grid, 1st det.-----	SC-D-970
R ₄₉ -----	3Z4533-----	Resistor RS-133-----	Carbon, insul.; 500,000 ohms, ½ w.	R. f. filter, diode.-----	SC-D-970
R ₅₀ -----	3Z4540-----	Resistor RS-140-----	Carbon, insul.; 30,000 ohms, ½ w.	Screen grid, 1st det.-----	SC-D-970
R ₅₁ -----	3Z4529-----	Resistor RS-129-----	Carbon, insul.; 10,000 ohms, ½ w.	Filter load, c. w. osc.-----	SC-D-970
R ₅₂ -----	3Z4575-----	Resistor RS-175-----	Carbon, 10,000 ohms, ½ w.	A. v. c. filter, 1st i. f.-----	SC-D-970
R ₅₃ -----	3Z4573-----	Resistor RS-173-----	Carbon, 2 megohms, ½ w.	Grid, 1st r. f.-----	SC-D-970
RL ₁ -----	2Z7613-----	Relay BK-13-----		Antenna grounding-----	SC-D-1942
SO ₁ -----	2Z8794.1-----	Socket SO-94-----		Power supply and control-----	SC-D-2592
SW ₁ -----	3Z8131-----	Switch SW-131-----	Toggle-----	Send-receive-----	SC-A-1042
SW ₂ -----	3Z8310-2-----	Switch-----	Ganged-----	Band change, 1st r. f. grid-----	SC-D-2553
SW ₃ -----	3Z8310-1-----			Band change, 1st r. f. antenna-----	SC-D-2553
SW ₄ -----	3Z8310-2-----			Band change, 2d r. f. grid-----	SC-D-2553
SW ₅ -----	3Z8310-2-----			Band change, 1st r. f. plate-----	SC-D-2553
SW ₆ -----	3Z8310-2-----			Band change, 1st det. grid-----	SC-D-2553
SW ₇ -----	3Z8310-2-----			Band change, 2d r. f. plate-----	SC-D-2553
SW ₈ -----	3Z8310-2-----			Band change, r. f. osc. grid-----	SC-D-2553
SW ₉ -----	3Z8310-2-----			Band change, r. f. osc. plate-----	SC-D-2553

a. Radio receiver BC-312—Continued.

Reference No.	Stock No.	Name of part	Description	Function	Drawing No.
SW ₁₀ ----	-----	Switch-----	Ganged to C ₆₁ -----	Crystal switch-----	SC-D-2564
SW ₁₁ ----	3Z8105-----	Switch SW-105-----	Toggle-----	C. w. beat osc-----	SC-A-1042
SW ₁₂ ----	3Z8119-----	Switch SW-119-----	Rotary-----	Off MVC AVC-----	SC-D-2574
SW ₁₃ ----	3Z8131-----	Switch SW-131-----	Toggle-----	Heater switch-----	SC-A-1042
T ₁ -----	2Z9805-----	Transformer C-205-----	Audio frequency 5,000/2,500 turn ratio.	1st audio-----	SC-D-2567
T ₂ -----	2Z9760-----	Transformer C-160-----	Audio frequency 5,000/1,885 turn ratio.	2d audio-----	SC-D-2569
THS ₁ ----	2Z9182-----	Temperature control BK-12.	2.3 a., 14 v., normally closed--	Opens at 111° F-----	SC-A-2590
THS ₂ ----	2Z9181-----	Temperature control BK-11.	1.15 a., 14 v., normally closed--	Opens at 109° F-----	SC-A-2590

b. Radio receiver BC-312-C.—Replaceable parts of the radio receiver BC-312-C are identical with those parts listed in *a* above for the receiver BC-312 except as noted in (1), (2), and (3) below.

(1) *Additions.*—The following item is added in parallel with R_{31} ; R_{54} ; 3Z4623; resistor RS-223; wire-wound, insulated; 2,000 ohms, 1 watt; cathode bias, 2d audio.

(2) *Deletions.*—The following items are not used: capacitors C_{77} , C_{89} , C_{90} , C_{91} , C_{92} , C_{93} ; resistors R_{39} , R_{40} ; switch SW_{13} ; and thermostats THS_1 , THS_2 . Resistor R_{38} , the heater resistor of the BC-312, is not used as such. The resistor designated as R_{38} in the BC-312-C is actually a plate loading resistor in the 1st i. f. stage.

(3) Changes.

Reference No.	Stock No.	Name of part	Description	Function	Drawing No.
C ₃₂ -----	3D342-----	Capacitor CA-342-----	Mica; 100 μ f-----	1st i. f. grid coupling-----	SC-D-1993
C ₃₃ -----	3D344-----	Capacitor CA-344-----	Mica; 400 μ f-----	1st det. plate-----	SC-D-1993
C ₃₄ -----	3D371-----	Capacitor CA-371-----	Mica; 0.01 μ f.-450 v-----	1st det. plate bypass-----	RL-D-6222
C ₃₅ -----	3D344-----	Capacitor CA-344-----	Mica; 400 μ f-----	2d i. f. grid-----	SC-D-1993
C ₃₆ -----	3D371-----	Capacitor CA-371-----	Mica; 0.01 μ f.-450 v-----	2d i. f., a. v. c. bypass-----	RL-D-6222
C ₃₇ -----	3D344-----	Capacitor CA-344-----	Mica; 400 μ f-----	1st i. f. plate-----	SC-D-1993
C ₃₈ -----	3D371-----	Capacitor CA-371-----	Mica; 0.01 μ f.-450 v-----	1st i. f. plate bypass-----	RL-D-6222
C ₃₉ -----	3D371-----	Capacitor CA-371-----	Mica; 0.01 μ f.-450 v-----	1st i. f., a. v. c. bypass-----	RL-D-6222
C ₄₀ -----	3D342-----	Capacitor CA-342-----	Mica; 100 μ f-----	Diode input-----	SC-D-1993
C ₄₁ -----	3D342-----	Capacitor CA-342-----	Mica; 100 μ f-----	2d i. f. plate-----	SC-D-1993
C ₄₂ -----	3D371-----	Capacitor CA-371-----	Mica; 0.01 μ f.-450 v-----	Diode a. v. c. coupling-----	RL-D-6222
C ₄₃ -----	3D371-----	Capacitor CA-371-----	Mica; 0.01 μ f.-450 v-----	2d audio coupling-----	RL-D-6222
C ₄₄ -----	3D280-----	Capacitor CA-280-----	Variable air, with shaft; 1-10 μ f. 470 kc-----	C. w. osc. tuning-----	SC-A-1728
CX-----	3Z3501-6A-----	Crystal DC-6-A-----		Crystal filter unit-----	SC-D-2972
DM-----	3H1621-B-----	Dynamotor DM-21-B-----		D. c. power pack-----	SC-A-2581
FL-----	3Z1890-6B-----	Filter FL-6-B-----		D. c. power pack-----	SC-D-1866
F ₁ -----	3Z1921A-----	Fuse FU-21-A-----	10 a.-25 v-----	Dynamotor and filaments-----	
F ₂ -----	3Z1921A-----	Fuse FU-21-A-----	10 a.-25 v-----	Lamp circuit-----	
J ₁ -----	2Z5534A-----	Jack JK-34-A-----		1st audio phones-----	
J ₂ -----	2Z5534A-----	Jack JK-34-A-----		2d audio phones-----	
J ₃ -----	2Z5533A-----	Jack JK-33-A-----		Speaker jack-----	
J ₄ -----	2Z5533A-----	Jack JK-33-A-----		Microphone jack-----	

J ₆ -----	2Z5534A-----	Jack JK-34-A-----	Key jack-----	SC-D-2564-----
L ₂₃ -----	-----	Coils of transformer C-282-----	1st detector-----	SC-D-2564-----
L ₂₉ -----	-----	Coils of transformer C-283-----	1st i. f.-----	SC-D-2564-----
L ₃₀ -----	-----	Coils of transformer C-284-----	2d i. f.-----	SC-D-2564-----
R ₃₃ -----	3Z4569-----	Resistor RS-169-----	1st i. f. plate circuit loading-----	SC-D-970-----
			60,000 ohms, ½ w-----	

c. Radio transmitters BC-191-A and BC-191-C.

Reference No.	Stock No.	Name of part	Description	Function
-----	2C6191A-----	Radio transmitter BC-191-A-----	75 w-----	
-----	-----	Radio transmitter BC-191-C-----	75 w-----	
1101-----	2C6191A/S2-----	Socket-----	For VT-4-C-----	For m. o. tube.
1102-----	3Z9622-----	Switch, interlock-----	Pushbutton, nonlocking-----	High-voltage protection.
1103-----	-----	Capacitor-----	Thermal compensator-----	Thermal compensation of m. o. tank.
1104-----	-----	Capacitor-----	Part of 1103-----	Calibration reset.
1105-----	3DA6-4-----	Capacitor-----	0.006 μf. ± 10 percent, 2,500 v-----	M. o. plate bypass.
1106-----	2C6191A/D1-----	Choke-----	Fixed r. f.-----	M. o. plate.
1107-----	3DA20-6-----	Capacitor-----	0.02 μf. ± 10 percent, 1,000 v-----	Filament bypass.
1108-----	3D9100-12-----	Capacitor-----	0.0001 μf. ± 10 percent, 1,000 v-----	M. o. grid bypass.
1109-----	3Z6250-----	Resistor-----	2,500 ohms ± 5 percent, 15 w-----	M. o. grid bias.
1110-----	2C6191A/S2-----	Socket-----	For VT-4-C-----	For p. a. tube.
1111-----	3D9100-12-----	Capacitor-----	0.0001 μf. ± 10 percent, 1,000 v-----	P. a. grid bypass.
1112-----	3Z6400-1-----	Resistor-----	4,000 ohms ± 5 percent, 15 w-----	Part of p. a. grid bias.

c. Radio transmitters BC-191-A and BC-191-C—Continued.

Reference No.	Stock No.	Name of part	Description	Function
1113	2C6191A/R31	Resistor	3,000 ohms ± 5 percent, no taper, variable part of p. a. bias.	Mod. bias control.
1114	2C6191A/R31	Resistor	3,000 ohms ± 5 percent, no taper, variable part of p. a. grid bias.	S. a. bias control.
1115	3Z6720	Resistor	200,000 ohms ± 10 percent, 1 w.	Part of keying circuit.
1116	3Z6725	Resistor	250,000 ohms ± 10 percent, 1 w.	High voltage bridge.
1117	3DA1-9	Capacitor	0.001 μ f. ± 5 percent, 4,500 v.	P. a. plate power bypass.
1118		Choke coil	Fixed r. f.	P. a. plate.
1119	2C6191A/D2	Choke coil	Fixed r. f.	Negative high-voltage return.
1120	2C6191A/C5	Capacitor	1 μ f. -1,200 v., d. c.	R. f. bypass high-voltage supply.
1121	3F222.1	Ammeter IS-22	500 ma., d. c., blocked in red from 210 to 220 ma.	TOTAL PLATE CURRENT meter.
1122	3Z5927	Lamp LM-27	6.3 v., 0.25 a.	Pilot lamp.
1123	3Z6003-3	Resistor	30 ohms ± 10 percent, 5 w.	Series with 6.3 v. lamp.
1124	3Z6003-3	Resistor	30 ohms ± 10 percent, 5 w.	Series with pilot lamp in control box BC-309.
1125	2Z8754	Socket SO-54	Alternate connection 1173 for plug PL-74.	Cording.
1126	2Z8741	Socket SO-41	Alternate connection 1174 for plug PL-61.	Cording.
1127	2Z8739	Socket SO-39	Alternate connection 1175 for plug PL-59.	Cording.
1128	2Z8744	Socket SO-44	Alternate connection 1176 for plug PL-64.	Cording.
1129	2Z5533A	Jack JK-33-A		Microphone.

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1130	2Z5534A	Jack JK-34-A	Key.
1131	3Z9622	Switch	Test key.
1132	3Z9623	Switch OFF ON	Filament and dynamotor circuits.
1133	3F7322	Voltmeter IS-122	Filament voltages.
1134	3DA10-17	Capacitor	R. f. bypass on voltmeter.
1135	3Z8106	Switch SW-106	C. w. filament or mod filament voltage.
1136	3Z9624	Switch AC DC	A. c. or d. c. operation of filaments.
1137	3Z9624	Switch AC DC	A. c. or d. c. operation of filaments.
1138	2C6191A/R5	Resistor	Filament voltage adjustment.
1139	3Z9624	Switch 12v 14.2v	For 12 v. or 14.2 v. battery voltage.
1140	3Z9624	Switch 12v 14.2v	For 12 v. or 14.2 v. battery voltage.
1141	3Z9625	Switch selector TONE C'W VOICE.	Select tone c. w. or voice operation.
1142	3DA1-10	Capacitor	Oscillator feed back on tone or c. w.
1144	3DB1.1A	Capacitor	S. a. grid bypass.
1145	3Z6005-2	Resistor	Microphone circuit.
1146	2C6191A/K1	Reactor	Microphone filter item.
1147	2C6191A/C9	Capacitor	Microphone filter item.
1148	2C6191A/R32	Resistor	S. a. input level control.
1149	2C6191A/T3	Transformer	Input to s. a.
1150	3DA1-7	Capacitor	Resonating capacity on tone or c. w. operation.
1151	3Z6020-4	Resistor	Grid bias stabilization.

c. Radio transmitters BC-191-A and BC-191-C—Continued.

Reference No.	Stock No.	Name of part	Description	Function
1152	3Z5991-2	Resistor	1 ohm $\pm$ 5 percent, 5 w	Filament s. a. tube.
1153	3Z5991-2	Resistor	1 ohm $\pm$ 5 percent, 5 w	Filament s. a. tube.
1154	2Z8759	Socket	For VT-25	For s. a. tube.
1155	2C6191A/C5	Capacitor	1 μ f. — 1,200 v. d. c.	S. a. plate bypass.
1156	3Z6611-1	Resistor	11,000 ohms $\pm$ 5 percent, 15 w	S. a. plate, voltage reducing.
1157	2C6191A/T2	Transformer	Interstage	S. a. to mod. grids.
1160	3DB1.1A	Capacitor	1 μ f. $\pm$ 10 percent, 300 v. d. c.	Mod. grid bypass.
1161	2C6191A/S2	Socket	For VT-4-A	Modulator tube.
1162	2C6191A/S2	Socket	For VT-4-A	Modulator tube.
1163	2C6191A/C5	Capacitor	1 μ f. — 1,200 v. d. c.	Mod. plate power bypass.
1164	2C6191A/T1	Transformer	Modulation	Mod. tubes to p. a.
1165	2C6191A/L1	Relay	Antenna switching	Antenna switching and transmitter keying.
1166	3F289	Ammeter IS-89	8 a., r. f., with internal thermocouple.	
1167		Inductor	Rotating continuously variable	ANT IND TUNING.
1168	3Z9626	Switch	4 position	ANT CIRCUIT SWITCH.
1169		Capacitor	22 to 118 μ f	Antenna tuning.
1170		Inductor	Tapped inductor	Antenna loading.
1171	3Z9627	Switch	5 position	ANT IND SWITCH.
1172	3Z1912	Fuse FU-12	.5 a., 1,000 v	High-voltage supply.
1173	2Z8754	Socket SO-54	For plug PL-74	Cording.
1174	2Z8741	Socket SO-41	For plug PL-61	Cording.
1175	2Z8739	Socket SO-39	For plug PL-59	Cording.
1176	2Z8744	Socket SO-44	For plug PL-64	Cording.
1177	2Z5533A	Jack JK-33-A		Microphone.

1178	2Z5534A	Jack JK-34-A	Single section, one circuit, four point, nonshorting.	Key. SIDE TONE adjustment.
1179	3Z9610A	Switch	0.01 μ f. $\pm$ 5 percent, 2,500 v	Plate resonating capacitor, tone, and c. w.
1180	3DA10-13	Capacitor	30,000 ohms $\pm$ 5 percent, 1 w	Mod. grid stabilization.
1181	3Z6630-4	Resistor	50 ohms $\pm$ 10 percent, 5 w	Microphone circuit.
1182	3Z6005-2	Resistor	Parallel with 1184	Parasitic resistor.
1183	3Z6010-6	Resistor	R. f. parallel with 1183	Parasitic choke.
1184		Choke	1 μ f. $\pm$ 10 percent, 300 v. d. c.	Keying filter.
1185	3DB1.1A	Capacitor	5 ohms $\pm$ 5 percent, 3 w	Keying filter.
1186	3Z5995	Resistor		

d. Transmitter tuning unit TU-5-A.

Reference No.	Stock No.	Name of part	Description	Function
	2C8005A	Transmitter tuning unit TU-5-A.		
501		Inductor	R. f. fixed.	M. o. tank.
502	3Z9614	Switch	Ganged with 522, 4 position	BAND CHANGE SWITCH.
503	3D9100-11	Capacitor	0.0001 μ f. $\pm$ 5 percent, 3,000 v	M. o. tank, band change.
504	3D9100-11	Capacitor	0.0001 μ f. $\pm$ 5 percent, 3,000 v	M. o. tank, band change.
505	3D9100-11	Capacitor	0.0001 μ f. $\pm$ 5 percent, 3,000 v	M. o. tank, band change.
506	3D9030-1	Capacitor	0.00003 μ f. $\pm$ 5 percent, 2,000 v	M. o. tank.
507		Capacitor	135 μ f. max. $\pm$ 2 percent, 20 μ f. min. $\pm$ 1 percent.	M. o. tank, variable.
508	2C8005A/D10	Choke	With resistor 517	P. a. grid circuit.
509	3D9400-6	Capacitor	0.0004 μ f. $\pm$ 10 percent, 5,000 v	P. a. grid blocking.
510	3D9400-6	Capacitor	0.0004 μ f. $\pm$ 10 percent, 5,000 v	P. a. grid blocking.

d. Transmitter tuning unit TU-5-A--Continued.

Reference No.	Stock No.	Name of part	Description	Function
511	2C8005A/D11	Choke	R. f. fixed	M. o. grid.
512		Capacitor	8 to 26 μ f	Neutralizing.
513		Capacitor	Parallel to 503	Thermal compensator.
514		Capacitor	Parallel to 504	Thermal compensator.
515		Capacitor	Parallel to 505	Thermal compensator.
516		Capacitor	Parallel to 506	Thermal compensator.
517	3Z6001E5	Resistor	15 ohms, 4.5 w., with 508	P. a. grid parasitic.
521		Inductor	R. f. fixed	P. a. tank.
522	3Z9614	Switch	With 502, 4 position	BAND CHANGE SWITCH.
523	3D9090	Capacitor	0.00009 μ f. $\pm$ 5 percent, 3,000 v	P. a. tank, band change.
524	3D9090	Capacitor	0.00009 μ f. $\pm$ 5 percent, 3,000 v	P. a. tank, band change.
525	3D9090	Capacitor	0.00009 μ f. $\pm$ 5 percent, 3,000 v	P. a. tank, band change.
527		Capacitor	20 to 156 μ f	P. a. tank, variable.
528		Inductor	Tapped	Antenna coupling.
529	3Z9605A	Switch	6 position	ANT COUPLING SWITCH.

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e. Transmitter tuning unit TU-6-A.

Reference No.	Stock No.	Name of part	Description	Function
	2C8006A	Transmitter tuning unit TU-6-A.		
601		Inductor	R. f. fixed	M. o. tank.
602	3Z9612A	Switch	2 position, ganged with 622	M. o. tank, band change.
603	3D9050-3	Capacitor	0.00005 μ f. $\pm$ 5 percent, 3,000 v	M. o. tank, band change.
607		Capacitor	77 μ f. $\pm$ 2 percent max., 15 μ f. $\pm$ 1 percent min. variable.	M. o. tank.
608	3C8006A/D14	Choke	With resistor 614	P. a. grid.
609	3D9400-6	Capacitor	0.0004 μ f. $\pm$ 10 percent, 5,000 v	P. a. grid blocking.
610	3D9400-6	Capacitor	0.0004 μ f. $\pm$ 10 percent, 5,000 v	M. o. grid blocking.
611	2C8006A/D15	Choke	R. f. fixed	M. o. grid.
612		Capacitor	8 to 26 μ f	Neutralizing.
613		Capacitor	Parallel to 603	Thermal compensation.
614	3Z6001E5	Resistor	15 ohms, 4.5 w	Parasitic p. a. grid.
621		Inductor	R. f. fixed	P. a. tank.
622	3Z9612A	Switch	2 position ganged with 602	P. a. tank, band change.
623	3D9050-1	Capacitor	0.00005 μ f. $\pm$ 5 percent, 3,000 v	P. a. tank, band change.
627		Capacitor	19 to 116 μ f. variable	P. a. tank.
628		Inductor	Tapped	Antenna coupling.
629	3Z9605A	Switch	6 position	ANT COUPLING SWITCH.

f. Radio control box BC-309.

Reference No.	Stock No.	Name of part	Description	Function
1301	2Z8754	Socket SO-54	For plug PL-74	Cording.
1302	3Z9847	Switch	Toggle	Transmitter OFF ON.
1303	2Z5534A	Jack JK-34-A		Key.
1304	3Z5927	Lamp LM-27	6.3 v., 0.25 a.	Pilot lamp.

g. Dynamotor unit BD-77-A.

Reference No.	Stock No.	Name of part	Description	Function
1601	2Z8741	Socket SO-41	For plug PL-61	Cording.
1602	2Z8739	Socket SO-39	For plug PL-59	Cording.
1603		Relay		Starting.
1604	3Z1913	Fuse FU-13	30 a., 250 v.	To transmitter.
1605	3Z1922	Fuse FU-22	60 a., 250 v.	To dynamotor.
1606	3H1777AA	Dynamotor	14/100 v., 5,000 r. p. m.	High-voltage supply.
1607		Capacitor	.005 μ f. $\pm$ 5 percent, 5,000 v.	High-voltage filter, bypass.
1608		Fuse FU-18-A	1 a., 1,000 v.	High-voltage supply.
1609	3DA10-17	Capacitor	.01 μ f., 1,000 v.	Low-voltage filter, bypass.

h. Mountings.

Reference No.	Stock No.	Name of part	Description	Function
-----	3H3907	Mounting FT-107	-----	For use with dynamotor unit BD-77-A.
-----	2Z6665B	Mounting FT-115-B	-----	Disposable for use with radio transmitter BC-191-A.
-----	3Z6691A	Mounting FT-151-A	-----	For use with radio transmitter BC-191-A.

[A. G. 062.11 (1-10-41).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

DISTRIBUTION:

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